August 1897
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plates 71, 72 details
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Plates. {University of Virginia Buildings.
McKim, Mead & White, Architects.

THE BRICKBVILDER

· DEVOTED TO THE ·
· INTERESTS OF ·
ARCHITECTVRE
IN MATERIALS OF CLAY

PUBLISHED MONTHLY
By Rogers & Manson,
Office, 85 WATER STREET, BOSTON, MASS.

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THE BRICKBVILDER

OFFICE 85 WATER STREET BOSTON

THE BRICKBUILDER.

AN ILLUSTRATED MONTHLY DEVOTED TO THE ADVANCEMENT OF ARCHITECTURE IN MATERIALS OF CLAY.

PUBLISHED BY

ROGERS & MANSON,

CUSHING BUILDING, 85 WATER STREET, BOSTON.

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AT the possible risk of wearying some of our readers, we feel constrained to recur to a subject of which we have frequently spoken in these pages, viz.: the consideration of bond in brickwork and the necessity of a uniform size for bricks. It is a melancholy and somewhat humiliating fact that under existing conditions the quality of brickwork is — all things considered — probably worse in America than in any other civilized country, while the quality of bricks is often better than elsewhere. All know our usual methods of building brick walls. The interior partition and bearing walls are invariably built with no less than four, oftener six or seven, courses, all stretchers followed by one course of headers, the resulting bond being necessarily very imperfect. As the mortar is frequently of poor quality, the wall so built has very little transverse strength. In case of fire, the falling beams frequently bring considerable lateral pressure to bear upon the walls, and our brick walls are frequently overthrown in fires, when walls, properly built and bonded, would stand and check the fire. There can be no doubt that the greater destruction caused by fires in this country, even in our masonry buildings, is largely to be ascribed to this cause. No one factor is more important in fighting fires, as every fire captain would testify, than to have walls which can be depended upon to stand, and which will serve as ramparts against the fire. On this account lateral strength is usually more important than longitudinal strength in a wall. The bond in which transverse and longitudinal strength are equal is one cause of headers to two of stretchers; but even such a bond as this is almost never found in the interior walls of buildings in this country.

With regard to the exterior walls the case is even worse. Until quite recently, the ideal of an exterior brick wall was one of brick, carefully culled to give the greatest uniformity of color and laid all stretchers, the front skin of face brick tied to the backing only by cutting off occasional bricks at the back and tailing bricks in behind the cut brick into the backing, or by using hoop iron bond. In either case the tie is so slight that the facing adds practically nothing to the strength of the wall. Such a wall is as bad artistically as it is constructionally. The even and hardly visible jointing and the uniformity of color produce a surface absolutely devoid of character or interest, and without the charm of color, which comes naturally and inevitably where bricks are used without culling, and are laid with joints sufficiently wide to tell in the color scheme.

Of late, since our architects have been learning the beauty of color variety in brick, and the value of the jointing as an element in the color and texture of the wall, these walls of monotonous sameness have become less common. Not only have bricks of russet, buff, and other colors been introduced, but even the red bricks are very often laid without culling, as they ought always to be. The greater effectiveness and interest given to the appearance of a brick wall surface by the true English and Flemish bonds has also come to be appreciated, and these are more and more used in place of the insipid stretcher work which was invariable twenty years ago. Owing, however, to the fact that common bricks in this country are rarely made, as they ought to be, so that two headers with the intermediate joint will be just equal to a stretcher, it is difficult and expensive to make use of these bonds. The width of the brick in relation to its length is usually too short, and the result is that the strongest of these two bonds, the true English bond, can rarely be made use of, without cutting the brick to avoid the vertical joints coming over each other to the detriment of strength as well as appearance. For this reason the Flemish bond is more often employed; but even in this bond the headers can be brought over each other only with considerable pains.

An added difficulty arises from the fact that bricks from different kilns are of very different sizes; so that where a better grade of brick is desired for the facing, as is usually the case, it is difficult to find a brick for the backing that will bond with it and sometimes only by using a better quality of brick than is really required. These difficulties result too frequently in the vicious practise of building a face wall with a sham Flemish bond, the bricks being cut in half to form sham headers, true headers being used only every three or four courses where the courses of the facing and of the backing happen to come to the same level, or sometimes headers are inserted when the two are not quite on a level, and the outer skin, being so largely independent of the backing, settles a little differently and the few headers are cracked in two by uneven settling. All this encourages the bricklayer in slipshod, careless, and unworkmanlike methods. He has little or no opportunity to show what he is really capable of, or to become really interested in the finer points of his craft, such as the laying of the more complicated bonds or brick pattern work. Indeed, he hardly even masters the laying of good English and Flemish bond, so that these are more expensive to lay than they ought to be from sheer unfamiliarity of the workman as well from the unnecessary difficulties resulting from the uneven sizes and bad shapes of the brick. All this group of difficulties harks back to the one fruitful source of the trouble: the fact that brick manufacturers have not been able to

agree upon, and rigidly adhere to, a proper standard size of brick which should apply to face-brick and common brick alike. No doubt some manufacturers purposely make their brick undersized, in order to sell a larger number, but such men are a small minority, we are glad to believe.

It is within the power of the manufacturers to combine and enforce a proper standard size. The difficulty of making allowance for differences of shrinkage in different clays is not insurmountable. Such a policy rigidly carried out would greatly encourage the use of brick and would bring about its employment in many cases where stone is now employed on the one hand, and where wood is employed at the other end of the scale. We are sure the architects would encourage such a movement by specifying standard size brick if they could readily be obtained. We wish the manufacturers could see that their own best interest lies this way, that they could greatly increase the use of brick by such a policy. The makers of pressed brick would find it to their interest to bring pressure to bear on the makers of common brick to adopt the standard size. We are sure that in this way the use of pressed brick would be increased. The better work that would result from the proper bonding between face and backing would make brick walls more durable than they now are. We are sure a rich harvest is in store for those who inaugurate the reform, and who bring it to the attention of architects.

PERSONAL AND CLUB NEWS.

Mr. H. W. Buemming, architect, has opened an office in the Pabst Building, Milwaukee.

Mr. Gould has retired from the firm of Gould, Angell & Swift, architects, Providence, R. I. Messrs. Angell & Swift will continue the business at the same office.

Recent events at the Chicago Architectural Club: December 28, annual Christmas-tree celebration; January 4, paper by R. E. Richardson, explaining the electrical terms and conditions as met with by architects; January 11, reception; Messrs. W. H. Eggebrecht, H. D. Jenkins, and E. S. Seney acting as hosts.

At the annual meeting of the St. Louis Architectural Club, held January 2, the following officers were elected: President, W. B. Ittner; first vice, Ernest Helfensteller; second vice, J. C. Stephens; secretary, G. F. A. Breuggeman; treasurer, C. H. Dietering. These with Oscar Enders and J. L. Gray will constitute the executive board.

The first regular meeting of the Pittsburg Architectural Club was held in their new quarters, Carnegie Library Building, Wednesday evening, December 16. The following officers were elected: President, Frank A. Large; vice-president, Jno. T. Comes; secretary, Chas. I. Ingham; treasurer, Miss Elise A. Mercur. Executive committee: Chas. W. Tufts, Robert G. Dickson, Miss McMasters, H. Childs Hodgins. The constitution and by-laws submitted at a former meeting were adopted as drafted.

The Twelfth Annual Exhibition of the Architectural League of New York will open February 20, in the building of the American Fine Arts Society, 215 West 57th Street, and continue to March 13 inclusive. Hours 10 A. M. to 6 P. M., 8 P. M. to 10 P. M. Sundays, 1 P. M. to 6 P. M. and 8 P. M. to 10 P. M.

Exhibit entry blanks returnable Monday, February 1.

Last day for reception of exhibits, Wednesday, February 10, 6 P. M.

The New Jersey Society of Architects held its regular monthly meeting at the parlors of L. Achtel Stetter, Newark, N. J., on January 7. Assemblyman McArthur, of Jersey City, addressed the meeting regarding his proposed new State building law applying to cities of the first and second classes. After discussion the matter was referred back to the committee having it in charge.

We have received the catalogue of the Architectural Exhibition held by the T Square Club at the Pennsylvania Academy of the Fine Arts, Philadelphia, in connection with the sixty-sixth annual exhibition of painting and sculpture. It is a publication creditable alike to the profession which makes it possible, and to the club which has brought together so much good material. The value of publications of this sort is very readily appreciated. Indeed, it is possible that as much general, tangible good is accomplished by the publication of the catalogue as by the holding of the exhibition, which it in part illustrates; for while the exhibition passes, and is apt to share the fate of most all architectural exhibitions in that the general public is not in evidence, the catalogue is a thing to be treasured and preserved in the architects' offices, and cannot fail to be an educational factor. This book adds to the laurels of the T Square Club, an organization which now easily ranks as one of the most active professional bodies in the country. This catalogue has one innovation in the shape of a very excellent color reproduction of the drawing of the doorway of Santa Paula, Seville, by A. C. Munoz. This is, as far as we know, the first instance of color being used in connection with an architectural catalogue, and it is very successful.

ILLUSTRATED ADVERTISEMENTS.

The adjoining illustration shows the doorway to a residence in Brooklyn, N. Y., the whole of which is executed in terra-cotta and brick. Montrose W. Morris is the architect, and the work was made by the New York Architectural Terra-Cotta Company. In the advertisement of the company for this month, on page xxviii,

is shown the alternate of Mr. Aldrich's design which was premiated in the competition held by the company.

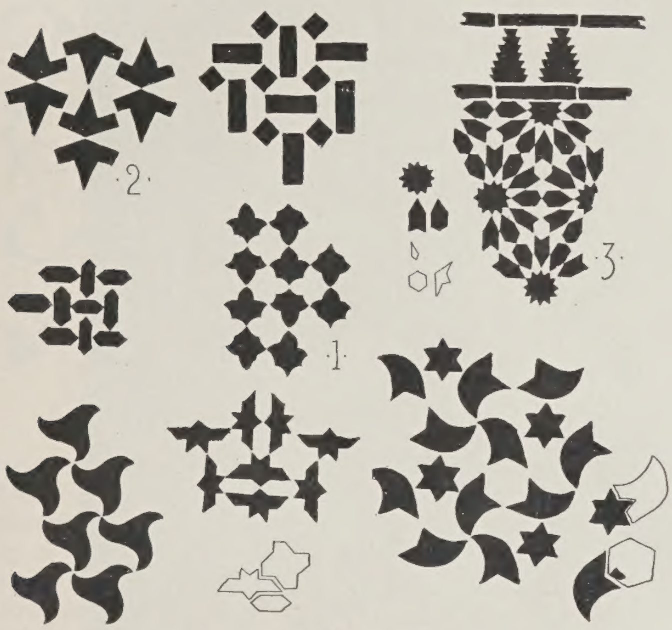
In the advertisement of R. Guastavino, page xiv, the fire-proof tile dome over the rotunda of the library for the University of Virginia is shown. The library is one of the group of new university buildings by McKim, Mead & White, and the illustration shows to good advantage Mr. Guastavino's system of fire-proof tiling.

A splendid illustration of Macmonnies' Bacchante, which was presented by Mr. Charles F. McKim to the Boston Public Library, is shown in the advertisement of Mr. F. B. Gilbreth on page xxxiv.

Spanish Brick and Tile Work. IV.

BY C. H. BLACKALL.

SINCE the publication of the last paper upon this subject, the writer has been able to verify his expressed surmise in regard to the character of the work in the doorway of Santa Paula, at Seville. The faience was modeled by one of the most promising pupils of the Della Robbias, who established himself in Spain after



MOORISH TILE PATTERNS.

a long course of study in Italy. While this does not add to the artistic merit of the work, the fact is of interest.

There remains only one manifestation of Spanish ceramic art to be included within the scope of this paper, namely, the enameled tiling. It is hard to speak dispassionately of Spanish tiles. From a practical standpoint they leave a great deal to be desired, as the workmanship is almost invariably crude and the enamel is applied to a very inferior grade of terra-cotta; but in an artistic sense it is doubtful if the world has ever seen ceramic work which was, on the whole, so eminently successful; and with the exception of what has been accomplished by the Persians and by a few of the Northern races in India, there are no other encaustic or enameled tiles known to us at present which can approach the Spanish work for brilliancy of design combined with a strictly decorative treatment of mass and a harmony of colors. All periods of modern art have been inspired very directly by these wonderful creations. The very term "Majolica" comes from the name of an island lying off the coast of Spain, in which the fabrication of vitreous enamels at an early period of modern history began to assume a high importance, and from whence the secret of the manufacture was spread over Europe. All of the Semitic races have been inclined to tile work, and even as far back as the days of the Assyrian monarchies encaustic tiling was a recognized and very successful medium of adornment, while the enamels and potteries of Damascus, of lower Egypt, of Bagdad, and of Ispahan, have been prized by artists and collectors for many generations. It is then not strange that the Moors, who inherited the artistic tendencies of their Asiatic forbears, should, when removed to the security of the Spanish Moslem empire, with ample means at command and a degree of security from external political complications such as the Arab races never enjoyed elsewhere, be able to carry their decorative tendencies to the highest perfection. Moorish art was a matter almost purely of detail, and, owing to the peculiar, seclusive manner of life which this strange race preserved for so many centuries, there are very few manifestations of external architecture or decorative art. There are a few instances, such as the exquisite structure in the enclosure of the Alhambra, known as the Wine Gate, in which a species of external ceramic treatment was tried by the Moors; but, as a rule, the exteriors of the buildings erected by them were somber and uninteresting, and the lavish imaginative qualities of their arts and sciences were reserved for the privacy of the interior.

The Moorish tiles were formed from a stiff but not very hard clay, which was squeezed into molds so that the individual pieces were slightly beveled on the edges towards the back, permitting of very fine joints, if such were desired, though more commonly the tiles were so bedded in a matrix of mortar as to leave broad and somewhat irregular joints, the bevel of the tile allowing the mortar to key thoroughly around each piece. The colors were applied in the shape of enamels, rarely any glazes or transparent colors being used. In the early Moorish work, tiling, whether for dados or floors, was treated purely as a mosaic, a pattern being evolved by the combination of a few forms repeated in a geometrical arrangement. Thus, in Fig. 1, the pattern is made by only two tiles of different colors. Figs. 2 and 3 are likewise made with a single shape in different colors, and even so complicated a pattern as the one shown by Fig. 3 requires only three forms of colored and three of white tiles to build up the entire design. In the later Moorish period the strictly mosaic treatment was abandoned, and we find tiles on which the patterns were stenciled over a white ground so as to reduce the manual labor of setting in place, while after the Christian conquest the tiles were frequently in slight relief, the pattern stamped in the moist clay and the impressions filled with the liquid enamel to produce the different effects of pattern and color. Attempts have frequently been made in recent years to copy the effects of the Moorish tiling, but while the raised and stenciled tiles can easily be adapted to our present conditions, it would require at least a generation of education to so train our mechanics as to be able to set the intricate mosaics which the early Moors used so constantly for their walls and floors; and aside from any question of expense, which would be a considerable factor, it would hardly be practicable to undertake to reproduce the Moorish tiles in our work.

The colors of the Moorish tiles are mostly green, blue, black,

PATTERN OF EXTERIOR WALL TILES FROM LISBON.

white, and yellow, the green, white, and black combination largely predominating. There seems to be very little variety in tones used, as the colors are practically the same in nearly all the Moorish work

INTERIOR OF TOWER OF THE CAPTIVE, THE ALHAMBRA.

now remaining, the variety of treatment and diversity of effect having been produced entirely by changes in the pattern or in disposition of colors. There are two groups of buildings which are preeminent among the existing examples of Moorish construction wherein tiles were used for decorative treatment. The Alcazar at Seville is one of the royal residences which was erected by Moorish workmen for the

PATTERN OF EXTERIOR WALL TILES FROM LISBON.

early Christian conquerors; and although it is not, strictly speaking, a Moorish product by ownership, it is such by the character of the work, debarring a few of the more modern changes. This building has been very carefully restored, is kept in exquisite repair, and serves as perhaps, on the whole, the best example in which the Moorish styles can be studied, though the treatment in a decorative sense is not as pure as in some of the other instances. The interior consists of a vast succession of apartments grouped around interior courts, the whole ornamented with lavish Moorish details, and with a wealth of tiling in the shape of wainscotting and paving, all of which is, in an artist's sense, none the less entertaining because of the rococo additions of later date or the charming tropical gardens which close the vistas of the broad halls.

The Alhambra of Granada is the structure which is most intimately associated with Moorish work. It is, properly speaking, a collection of buildings erected upon the spur of a hill jutting out into the valley above the city, and includes a number of structures of different periods, which until quite recently were sadly dilapidated and almost totally neglected. Of late years, however, the Spanish government has restored a very considerable portion of the Moorish work in a most intelligent manner, and as far as concerns the details of design, the interior gives a very fair idea of what the Moors attempted to produce. Any one who has seen this work in place is sure to retain a very vivid impression of how it looks and what it is, but any attempt to describe it without the aid of color is almost hopeless; for while the Moors placed a great deal of insistence upon the design, and their keen geometric taste enabled them to evolve most surprising results with very simple motives, yet color was so essentially a part of the whole that mere black and white reproductions absolutely fail to convey exact impressions. Furthermore, it is to be doubted whether the Alhambra as it exists to-day in its most carefully restored portions can be a correct representation of Moorish art. The rooms are grouped around courts, and there is plenty of sunshine and a certain amount of green foliage at the end of each vista, so that surprises await one at every turn; and the succession of halls and corridors, with their enameled surfaces, is very fascinating; but the absence of life, the lack of fittings, make even this fairy-like palace seem very dreary. We all know how hopeless a new house seems before it is carpeted or furnished, and the same applies to this Moorish work; it needs surroundings, it needs life, and all the thousand and one little things which add personal interest, in order to be anywhere near appreciated. The view which is reproduced of the interior of the Tower of the Captive is from a very brilliant water-color by G. Simoni, in "*Die Baukunst Spaniens*," and with the accessories so cleverly introduced, it gives, better than any photograph, an idea of what the Alhambra might be, in an inhabitable state.

Encaustic tile ceased to be used as a mosaic with the incoming of the Renaissance. The Spanish architects, however, produced some marvelously interesting work in this direction, and not only used tiles by themselves, but frequently carried ceramic painting to a very considerable extent. The illustration of the altar-piece and wall decoration is from one of the chapels of the cathedral at Seville. The whole of the decoration is in tile, and is one of the most ambitious examples of this particular phase of art which is in existence.

The extent of possible discussion of such a subject as this is almost without bounds, and I can accordingly only hint at the variety of treatment, the complexity of design, and the contrasts of color which result from the use of enameled tiles by the Moors and their successors in Spain. There is one manifestation, however, which I wish to notice. Lisbon is essentially Spanish in its art antecedents, and the ceramic manifestations of the Moors survive in Portugal to a greater extent than anywhere else on the peninsular. The street fronts of the houses are faced almost universally with enameled tiles. The idea is an excellent one; and properly developed, nothing more brilliant and interesting could be imagined than a long street, to say nothing of a whole city, clothed in all the beautiful hues which are to-day so easily produced by the ceramic artists. Plain white tiles are seldom used, though sometimes a single tone is employed. Blue is the color most employed, a blue pattern on a

ALTAR-PIECE, SEVILLE CATHEDRAL.

white ground, the tone being a cross between Delft and a French blue. The Portuguese have by no means perfected this mode of finish, or decoration, whichever it may be termed, although they have used it now for several centuries, and it is certainly a very interesting manifestation of possibilities.

Architectural Terra-Cotta.

BY THOMAS CUSACK.

(Continued.)

FROM the poetic to the severely practical may seem a long distance; in the present instance, however, it is but a step, such as the one we have now taken from the end of the last to the beginning of the present chapter. Thus far we have traced in sketchy outline the origin and application of burned clay from the building of Babel to the Christian era; thence through the Middle Ages, the Renaissance period, and onward to its modern revival in England, and subsequent introduction in America. We now take up the things of yesterday, to-day, and to-morrow, in this year of grace 1897, and we would fain hope, in a way that may prove helpful to those in whose hands lie its destiny in the coming century.

FIG. 7. HOFFMAN LIBRARY, ST. STEPHEN'S COLLEGE.

A time there was, and that not very long ago, when an architect having a desire to use terra-cotta was obliged to adopt some style admitting of comparatively small blocks. These he was advised to use in a more or less isolated manner, with brick filling as the connecting link. When not wholly detached, sundry expedients were frequently resorted to as a makeshift remedy for miscalculation in shrinkage, or, perhaps, a deviation from the figured dimensions in setting-out piers, openings, and breaks, etc., at the building. It was conceded, even by the manufacturers themselves, that in some instances the tail wagged the dog; and we fear that the practise, reprehensible though it be, has not yet been wholly abolished. This was merely yielding to difficulties, instead of adopting adequate means to overcome and finally end them. Available examples furnished by past ages were freely drawn upon, but failing to find a beau ideal from among them, the architect was expected to invent one suitable for immediate use. This he sometimes undertook to do, with remarkable promptitude but varying success. The mountain, he was informed, would not come to Mahomet, which for the nonce left the prophet but one alternative — pack his draughting paraphernalia, so to speak, and betake himself to the mountain. As a consequence, both design and construction were made subservient to the fancied as well as the real exigencies of the material. To some extent this is necessary,— for every material has its limitations,— but when it comes to fixing a standard of excellence by judicious compromise, we believe in leveling up rather than leveling down.

In the case of burned clay, however, everybody seemed inclined to capitulate, and allow this most excellent servant to become master of the situation. That undesirable state of things was not destined to last through an age of scientific research and mechanical invention. A race of men who have annihilated time and space by harnessing the unseen forces of nature, whether on land or sea, could not submit to the caprice of so simple an element. The action of fire upon a piece of selected and suitably prepared clay can be regulated and controlled with as much certainty as it can upon any other mineral. We state this advisedly, as a literal fact, and within certain limits, which we will hereafter endeavor to define; no competent architect need feel himself hedged in by irksome restraints, such as those to which he was at one time obliged to submit.

It is no longer a question of arbitrary style, having now resolved itself largely into one of treatment. Even in that there remains a world of latitude, in the hands of men who have profited by the observation of recently executed work, and feel an inclination to keep abreast with the times. Of course, if an architect has taken for his ideal the Temple of Karnack, or has set his heart upon a replica of the Parthenon, or has decided upon a reproduction of the Erechtheum, with, perhaps, monolithic columns and a trabeation admitting of joints only over centers of capitals, then there is but one, or at most two, things for him to do. He must go in search of a quarry capable of supplying the stones, and of a bank account from which to pay for them. But if, on the other hand, he can concentrate his ideas within the limits of classical Roman, Romanesque, Byzantine, Saracenic, Gothic from the thirteenth to the twentieth century, or any phase of Italian, French, or Spanish Renaissance, there is some hope for him. In any of these he can use terra-cotta throughout much as he would stone; or he can use it in combination with brick from basement to dome, minaret, spire, or campanile. All will depend upon his conception of these styles, and his way of handling any or all of them. One thing he must do: study the very wonderful capabilities of the material, without losing sight of its limitations. Great progress has been made by our best architects in these matters of late years. A large proportion of recent work bears the evidence of advanced thought and conscientious effort, usually in the right direction. Yet, judging from what we sometimes see done or attempted, there is still much to learn as to what may or may not be expected in the use of this material under given conditions. We hope, in succeeding pages, to contribute something towards a better understanding of the facts and principles underlying this aspect of the subject.

We are not writing for the behoof of men who, having failed in everything, take refuge behind a shingle of large size, on which has been painted the word ARCHITECT; by which magic name they seek to distinguish themselves from the great army of unemployed. They are past praying for. Our remarks are addressed primarily to men who have earned or are now earning their right to that title, and who have worn or intend to wear it honorably. We therefore take for granted their wide acquaintance with the merits of material in general. This much is essential to success under any circumstances. But when the material to be used is largely terra-cotta, a more exact knowledge of its physical characteristics is indispensable. To know as much as may be about the whys and wherefores of its manufacture will likewise greatly help them in using it to architectural as well as to commercial advantage. To that

end, we will turn from the general to the particular application of these observations, and instance a number of difficult yet every-day problems confined to work that has been or can be executed successfully. Attention will also be directed to some of the things which (as yet) cannot be made satisfactorily in terra-cotta, and that being so, is to our mind a sufficient reason why they should not be attempted. Like most things, this branch of our subject has a negative as well as a positive side, and to be of any real value the treatment must be unreservedly frank as well as intensely practical.

" I, from no building, gay or solemn,
Can miss the shapely Grecian column."

We will therefore begin with the column, which, in its diverse manifestations, affords as good an illustration as any we can think of as to what can and what can *not* be accomplished in terra-cotta. One of the most troublesome things to make is a full column that will withstand critical inspection on all sides. The difficulties begin to increase when the diameter exceeds 1 ft.; beyond that, the point is soon reached when they become insurmountable. If it be a three-quarter column, with an engagement on every alternate block for building into wall, most of these difficulties disappear, and the diameter may be increased to as much as 2 ft. and still remain practicable. In the former case we are speaking of plain shafts, but when severely fluted, the trouble is obviously increased. This is because of the extreme accuracy with which the arrises of the fillets have to fit, and the trueness of line required to make them presentable to the eye on close inspection. Macaulay's inspired schoolboy may not have known of the nicety demanded in working these drums in stone or marble, but every stone and marble cutter does. And when they have done their utmost, a good deal of faking still remains to be done after the column has been set in its position. This paring is not permissible in terra-cotta; for once the fired surface has been broken, a patch takes the place of an irregularity, and the remedy is, if anything, worse than the disease.

FIG. 4. ENTRANCE TO CASTLE SQUARE THEATER, BOSTON.

In the case of a 12 in. column with a height of, say, eight diameters, it would be jointed into five pieces, each weighing about 95 lbs. When the necessarily soft clay is pressed into a plaster mold, a proportion of the moisture is absorbed, and when ready for turning out to dry, it has acquired a considerable degree of stiffness. A safe-edge of ¾ in. has been allowed on each end, standing back about ¼ in. from the bottom of the flutes, to be trimmed off after burning. On this it is set to dry, first on one end, and then on the other, as shown on Fig. 1. Five eighths of the shrinkage takes place in the drying, and three eighths in the burning. In both cases the piece rests on a thin layer of coarse sand, each grain acting as a roller, which enables the circumference to travel more easily towards its center during the progress of contraction. But notwithstanding these and many other precautions, the weight of the piece, if it does not cause it to spread, is liable to impede the uniform shrinkage of the end on which it rests. Of course the greater the weight, the greater must be the impediment. If the column is jointed in three instead of in five (as architects will sometimes insist upon doing), the bottom third being parallel and the other two entasized, this burring on the ends is sure to happen. In that case the weight has been increased to 150 lbs. in a shaft of 12 ins. diameter, involving a corresponding uncertainty in fitting at the joints, as well as in the alignment of the pieces themselves.

But let us double the size of our column, viz., 2 ft. in which case it would be made (if made at all) in seven pieces of 2 ft. 8 ins. each. These would weigh 675 lbs., and, for the reasons just stated, may be considered altogether impracticable. If, however, "fools rush in," etc., as they sometimes will, and order a 2 ft. column complete drums without vertical joints, they may expect to pay for their enlightenment in regrets as endless as they will be useless. Some inexperienced manufacturer may take the order, and under pressure endeavor to go through with it, but in the end the architect will find that to order is one thing, but to execute is quite another matter.

In a three-quarter column, the conditions being reversed, the block can be turned out as at Fig. 2. The sanded board on which it lies being tilted to alternate ends at an angle of 30 degs., the shrinkage will be uniform, the block will be sound, and if reasonable care is exercised in its remaining vicissitudes, the ends will fit each other when set. A shaft of this kind can be made up to 2 ft. diameter, jointed in five pieces averaging 3 ft. 3 ins. long and weighing 700 lbs. But to make quite certain of the result, we would advise jointing it in seven pieces of 2 ft. 4 ins., thus reducing the weight to 490 lbs., and thereby securing a much greater uniformity in drying and burning. Four columns of this size and character are used on the Maryland Life Building, Baltimore, of which Mr. J. E. Sperry was the architect. In justice to him, however, we will say that he is not responsible for the jointing. Each shaft is jointed into twelve pieces, which are about five too many; and we cite this as an example to avoid, rather than one worthy of being followed. We are, of course, assuming a case in which it has been deemed imperative to make a column of this size in single blocks, without vertical joints, but do not wish to be understood as favoring that method.

Somewhat similar columns have since been made for the same architect, and are used on the Brewers' Exchange, Baltimore. They, however, are jointed vertically into alternating segments, one course being in two, and the next in three pieces, with the interior built of solid brickwork bonded into and forming part of the wall. The result is highly encouraging, and has given much satisfaction to the

architect. The same plan was adopted in constructing four attached columns used on the Castle Square Theater, Boston (Fig. 4). Messrs. Winslow & Wetherell were the architects in this case, and they, too, think the effect very successful.

In Fig. 5 we illustrate the construction of a Doric column; the first of its kind that we have seen attempted in terra-cotta. Two of them are used on the fourteenth story of the Central Syndicate Building, Broadway and Pearl Street, New York City. It has been remarked that the Greeks did not use columns of this kind on the fourteenth story. Had they lived in New York, however, they would ere this have been confronted with a condition, not a theory, and in that case, there is no telling what they *might* have done. The dotted lines on plan show how the courses break bond and tie each other without the necessity of extraneous anchors. In addition to the iron stanchion in center, the core is filled in with brick and cement, as in the instances just mentioned. The result compares favorably with similar columns in granite used on the first story of the same building. Taken altogether, we think this successful example will settle any doubts that may have existed as to the feasibility of constructing a Doric column in terra-cotta.

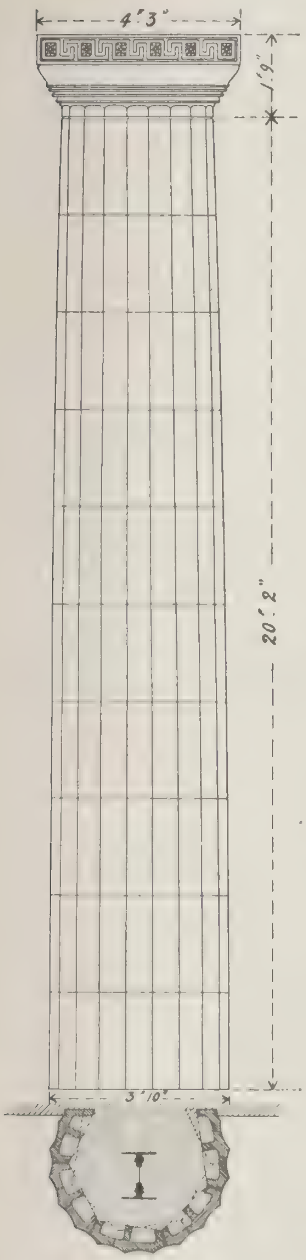


FIG. 5.

A full column, when it exceeds, say 1 ft. 4 in. in diameter, should be jointed up in segments of four or six pieces, according to size, the vertical joints being in the center of the flute. The height of the segment should not be more than one and a half times its width, and may be from 4 to 8 ins. in thickness, the back being left perfectly flat, so that it may be dried on a level board, as at Fig. 3. Columns of 2 ft. 10 ins. diameter have been made in three segments on plan to satisfy the scruples of architect and owner, who had at first insisted on having them in complete drums. When this method is adopted and the piece turned out of mold, the vertical joints, being radial, form an angle with the board on which it rests. This overhang will cause the sides to sag unless temporary supports (to be cut off before burning) are placed at intervals in the angle, as seen in Fig. 3, which is a quadrant. In the case just referred to the segments were 2 ft. 6 ins. wide, 2 ft. 8 ins. in height, by about 8 ins. thick in the center, and the columns so constructed may now be seen on the Chapin Building, Buffalo. We have seen a letter from the architect, Mr. F. E. Kent, in which he speaks in the most eulogistic terms of these columns after they had been set.

In Fig. 6 we illustrate a column of about the same general proportions. It, however, is made in six segments, and with base and capital has a total of 118 pieces. It will be noticed that the flutes on the lower part are not filled with the usual convex billet, but are slightly recessed, the surface being struck from the same center as the column, for which see enlarged flute at D. The termination at top is also somewhat uncommon, but not without warrant, though this treatment has been criticized in the hearing of the writer as unauthorized. In reply he ventured to quote as a precedent the Chapelle San Bernardino, at Verona, in which are columns practically identical in both these respects. The joints are intentionally emphasized in the drawing, and the three accompanying plans will show the construction. The core being of brick, laid in cement and all the interstices grouted, we get a shaft capable of sustaining an immense weight. But should still greater stiffness be required, a cast-iron core or a polygon of riveted steel sections may be introduced, giving an almost unlimited strength. Twenty-six of these columns were used by Mr. C. C. Haight on the Hoffman Library, St. Stephen's College, a view of which we give (Fig. 7) from a recent photograph. (*To be continued.*)

IN the course of a recent visit to New York City, I had occasion to view the Park Avenue front of the Murray Hill Hotel, itself an erection of yesterday; yet judged by the dilapidated condition of the red sandstone, it might have been built by Diedrich Knickerbocker. This is about the center of the brownstone high stoop district, at one time the Mecca of successful tradesmen, and still the homes of the elect, when "at home." The balustrades, basement walling, water tables, window trimmings, and even the flat ashlar veneers appear to throw off a coat of scale, from one to three eighths of an inch in thickness, every year or two. I was informed that this occurs with great regularity, until the advent of the boarding-house keeper, after which decay becomes more rapid, and demolition the inevitable adieu. I traversed several of the crosstown streets, and the difference between them from 18th to 59th was merely one of degree, but all bearing a close approximation to their age, which is premature, being from five to fifty years. It is no uncommon thing to see one of these fronts pulled down and replaced with Philadelphia, or latterly, with Pompeian brick and terra-cotta. A brownstone church on 7th Avenue near 14th Street, which was built in 1856, has just been demolished and rebuilt in cream-white brick and terra-cotta to match.

A similar state of transformation is going on in the downtown sections. Stone and marble fronts that were the pride of a past generation are giving place to granite lower stories with superstructures of terra-cotta and brick, behind which is a sinuous anatomy of riveted steel. Thus does evolution in all things emphasize the survival of the fittest.— *Correspondent.*

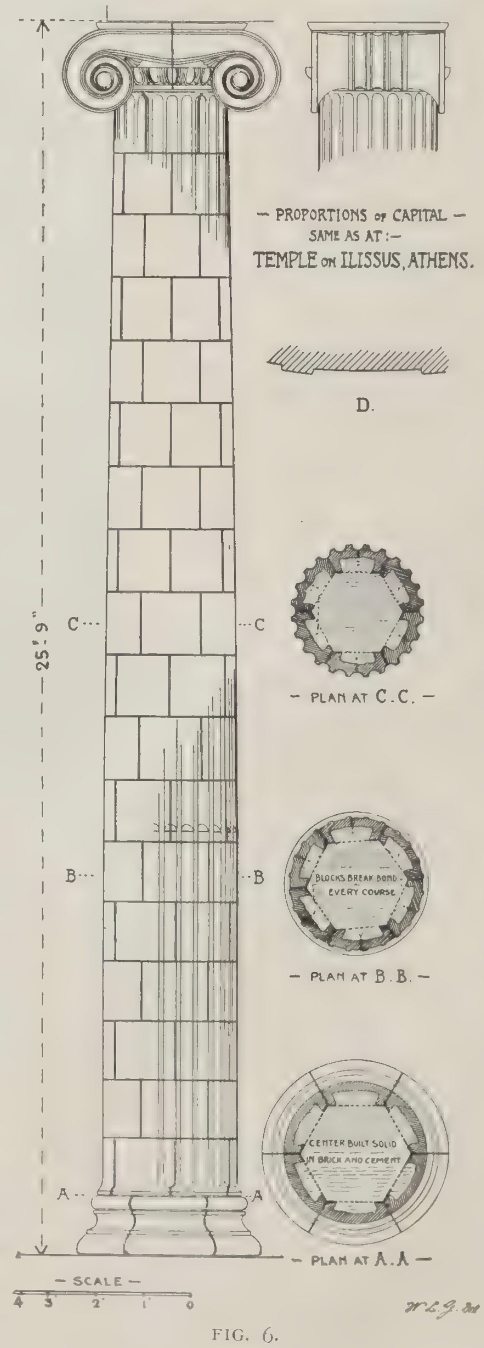


FIG. 6.

Fire-proofing Department.

SOME VALUABLE OPINIONS ON FIRE-PROOF CONSTRUCTION.

THE fire-proofing of our large commercial buildings is of such vital importance that, although as a science it is of quite modern development, its methods have of late years been the subject of many tests and special investigations made for the purpose of determining to what extent such precautions as are customarily taken serve their intended purpose. There have been several fires in buildings which are known commercially and scientifically as fire-proof structures, and though the actual damage resulting from such fires has, in most instances, been relatively quite slight, they have suggested very pertinent inquiry as to whether our materials are applied in the best and most scientific manner, and whether our fire-proofing systems are really fire-proof. Terra-cotta in one form or another has been very generally adopted for the protection of steel work and the construction of floors, and its properties and the details of its employment have received considerable study. With a view to determining the current opinion in regard to the use and the possibilities of terra-cotta, THE BRICKBUILDER has interviewed several of the leading architects in New York and Boston to ascertain whether in their judgment terra-cotta meets the requirements of the conditions of properly fire-proofing a building, and whether such a material, as a whole, can be depended upon.

Among those interviewed was Mr. George B. Post, of New York, who said that he considered sawdust or porous terra-cotta a most excellent material for resisting the combined action of fire and water, conditions which always arise in any burning building. In portions of the new twenty-five-story St. Paul Building on lower Broadway, and in the World Building, the Havemeyer, and in fact all of the large buildings which Mr. Post has erected, he has used the porous terra-cotta for fire-proof construction. Where the floor has to sustain a heavy direct load the end construction is the lightest and the strongest, but where lateral stiffness in the floors is desired, he believes the side construction to be the best adapted for the purpose. The ordinary builders, if left to themselves without the closest supervision, do not sufficiently fire-proof the floor openings in a building, and they are apt to ignore the fire-proofing of the girders. He believes, however, that the necessity for protecting the flanges of the beams is often exaggerated, and he cited the experience of the fire which a few years since burned out the upper stories of the building which he had erected for the Western Union Telegraph Company on Broadway. This fire originated in the low story which contained the batteries, and the heat was so intense that the granite window trimmings were destroyed and a couple of unprotected columns in the story were actually melted at their tops. The floor construction was of brick arches turned between the beams, and the lower flanges of the beams were protected by only five eighths of an inch of plaster. In the story above where the fire started there was one large room spanned by trusses. A gallery was hung from the floor beams, and after the fire it hung in festoons. So far as Mr. Post could ascertain, the floor beams and trusses, though protected so slightly in the lower flanges, suffered no appreciable damage. He infers from this that if the beams are thoroughly bedded in and covered by terra-cotta and mortar following any of the present forms which are in the market, it is not possible for a fire to dangerously affect the steel work. In his judgment, any of the recent and thoroughly well-constructed buildings which have been put up in New York can be called practically fire-proof, though in case of a great exterior conflagration he believes that in many buildings the skeleton construction would be sufficiently affected by unequal expansion to render the removal of the building necessary.

He believes that, on the whole, the forms of terra-cotta blockings and fire-proof shapes are satisfactory. He would not advise, however, any form which permitted of large or continuous voids in the thickness of the floor, unless such voids were blocked off at intervals by solid partitions. Other things being equal, he prefers a solid light filling between the beams.

It has been Mr. Post's practise to set the exterior columns of the steel skeleton well inside the wall of the building, separating them from the exterior construction by a waterproofing of some form and surrounding them thoroughly with cement grout and porous terra-cotta at least 4 ins. outside of the outer flanges of the steel. This is the construction which he used in the St. Paul Building, the outside walls being supported by the floor beams, which project beyond the columns and form cantilevers. He does not feel, in the light of his experience, that there is actual necessity for any terra-cotta under the flanges of the beam, though he usually specifies a thickness of 1¼ in. In the case of girders he specifies 2 ins. in thickness of terra-cotta around the flanges, which he believes is ample. For fire-proofing columns he uses nothing but terra-cotta. He does not believe that a dangerous heat would go through any of the present market constructions of terra-cotta fire-proofing if used in an intelligent and proper manner.

Mr. Francis H. Kimball, of Kimball & Thompson, New York, stated that, in his judgment, porous terra-cotta can thoroughly fire-proof all the construction of a building and is the best medium for the purpose on the market. He has used this material in the Manhattan Life Building, the Standard Oil Building, and a number of other large structures in New York. The flat arch construction, however, as ordinarily employed, is not absolutely satisfactory. It forms a good ceiling and answers the purpose of fire-proofing admirably, but the filling over the terra-cotta archings, composed of a low grade of concrete, is apt to settle and cause cracks in the finished tile floor construction. In his practise he has never used the end construction. He considers that the floor arches themselves are not called upon to really carry any load except their own weight, as in nearly every case continuous wooden sleepers are placed from beam to beam, which actually carry all of the superficial load. He uses skew-back blocks which lap under the beams 1 in., which he considers ample protection for the beam, and prefers such construction to the use of slippers. When asked as to whether the present systems of fire-proofing with terra-cotta blocks have been tested in actual use by fire and water so that we can be absolutely sure of their ultimate resistance, he said that there had been really no fires of any extent in the most recently constructed fire-proof buildings; consequently it is impossible to say that any of these structures have been submitted to extreme tests, but judging by such opportunities for observation as have arisen, it is possible to make a building absolutely fire-proof by the use of hollow terra-cotta. He instanced a test by fire of a building owned by the Potter estate, corner of 8th Street and Broadway, in which a steel column in the basement on the corner, which was covered with terra-cotta blocks and a thin layer of finished plaster, was exposed to a very intense heat from a fire in the surrounding stock of dry goods, and was subsequently, before being cooled to any degree, exposed to the action of water as well. Beyond the plaster being peeled off no damage occurred to the construction and the steel was not affected at all.

In the Manhattan Building, Mr. Kimball employed hard terra-cotta for the floor construction, but he would not be inclined to use the hard blocks again, as he preferred the porous. For fire-proofing columns his practise is to use terra-cotta with a thickness of at least 4 ins.

When asked as to the advisability of using stone outside the steel columns, he stated that he did not believe it could be relied upon to resist the flames. A statement often heard is that New York is building up so rapidly with large fire-proof buildings that it is not likely a conflagration could get started with sufficient impulse to extend very far. But right in front of the Manhattan Building, on the opposite side of Broadway, there is a large area covered with buildings with the ordinary wooden floor construction, which might,

under certain circumstances, get afire and produce a conflagration of sufficient intensity, if it should encounter a stone-faced building in its path, to entirely strip off the exterior stone facing in a few minutes, and leave the steel columns exposed to the action of the heat, with the inevitable result of the columns yielding and the whole building collapsing. He considered that for fire-proofing purposes 4 ins. of brick or terra-cotta would be better protection than a foot of stone, and that in a fire-proof floor the terra-cotta blocks ought to be bedded solidly around the beams. He suggested that instead of the concrete or cinders filling over the terra-cotta blocks, which is very customarily employed, it would be better either to have blocks made lapping under the beam, and the whole depth of the beam, or to fill in over the arch blocks with light terra-cotta. He had occasion some time since to make investigations in regard to the weight of the various fire-proof constructions, and he found that the ordinary cinders concrete would actually weigh about 90 lbs. per cubic foot, whereas terra-cotta blocks which would be amply sufficient for filling purposes need not weigh over 45 lbs. per cubic foot, a saving of 50 per cent., which in a building many stories high means a vast saving in the structural steel as well as in the foundation work. Mr. Kimball has used construction of this description and believes that it gives a floor which will not shrink nor allow the marble or tile work to crack. In the construction of the roof over Altman's store, he built up over the terra-cotta archings with porous terra-cotta blocks to obtain the necessary pitch to throw the water off. It is a very simple matter to make long filling blocks quite light, with end pieces so constructed as to lap over the top flange of the girder, setting these light blocks over the constructive arch blocks. This would give a light, absolutely fire-proof, non-shrinkable floor construction, which would be very stiff against lateral stress.

For fire-proofing about the webs and flanges of the girders Mr. Kimball advises 4 ins. of terra-cotta, and he has found it necessary to have special shapes made for this purpose. This was done in the Manhattan Building. In regard to exterior walls he has given considerable study to devising some system of construction which would be light, strong, and practically impervious to water. It is well known that a brick wall will soak water even in an ordinary storm, and a driving rain will beat through even 4 ft. of brickwork. He studied out a system employing constructive terra-cotta blocks, which he considers very adaptable for party walls above the roofs of adjoining buildings or any exterior wall where the surface can readily be got at. The visible exterior surface consists of 1 in. of Portland cement, the wall itself being built of hollow porous terra-cotta blocks laid in any thickness from 8 to 24 ins. The cement keeps out the moisture, and the blocks are light, strong, and warm, besides being absolutely fire-proof. He had a section of this construction set up for experiment and specified it for the Manhattan Building, but circumstances led to its being abandoned, though he considers it an excellent scheme. He would use such construction for party walls, gable ends, etc., and taken in connection with the steel frame it is possible to have it laid up so as to be thoroughly bonded and possess very nearly the rigidity of brick, while the weight is only about one third.

In conclusion, Mr. Kimball calls attention to the possible danger which might arise from a great conflagration even in so well built a city as New York, and stated that the system of fire-proofing by use of terra-cotta is perfectly satisfactory in theory, and can be developed in such a manner as to give the best results; but as often employed the details are very carelessly attended to, and the construction is usually not watched with sufficient care in ordinary building operations.

Mr. Bruce Price, of New York, called attention to the fact that there are many different forms of blocks for floor construction, some of them being very imperfect mechanically, and others as near perfect as could be expected of a material which has to be handled by all sorts of mechanics. He considers the end construction following the Maurer system one of the best which the market now affords, being fully 20 per cent. lighter than some of the other shapes and at least 25 per cent. stronger. As an instance of the strength of this type of floor, in the American Surety Building, erected from his plans, after the floor blocks were set in place blocks of granite weighing as high as 5 and 8 tons were dumped on the archings and worked over before being set, without the slightest damage to the construction. The weak part of the construction is the amount of protection to the flanges of the beams, which at the best is none too good, though this is a question of mechanical excellence rather than of suitability of material. He considers that in setting terra-cotta blocks only the best of Portland cement should be used. He believes terra-cotta to be an excellent material for partitions on account of its strength as well as its sound-proof qualities, while for resisting the spread of a fire the hollow blocks would undoubtedly last longer than anything else. In regard to fire-proofing on columns, when his clients and the conditions will permit, he employs terra-cotta, as he has found it perfectly satisfactory, and it answers every purpose of fire protection and solidity. Mr. Price prefers the hard-burned to the porous terra-cotta as he feels he can get the best results on ceilings and the resulting work is considerably stronger.

Mr. C. T. Wills, who was the builder of the American Surety Building as well as many other large structures in New York, said in reply to a question, that in his judgment it was a disadvantage to use porous terra-cotta for floor blocks on account of its tendency to absorb water. He considered the hard-burned terra-cotta amply sufficient protection against fire, as the heat would not go through either hard or porous to any extent. It is possible by using terra-cotta to build a structure which shall be absolutely fire-proof, and he felt that nothing else would give equal satisfaction, while as a matter of practical building construction, terra-cotta is by all odds the best material in the market.

Mr. E. A. Rogers, who was superintendent for Mr. Price on the Amercan Surety Building, stated that hollow terra-cotta blocks formed a construction for partition work which could be depended upon not to crack, warp out of plumb, or fail in being sufficiently stiff against lateral pressure. The blocks afford an excellent opportunity for passage of wires, pipes, etc., and will not heat through in case of a local fire in a single room. With the hard terra-cotta floor blocks which were used in the Surety Building there was no trouble whatever from moisture. For furring against outside walls nothing is more satisfactory than hollow terra-cotta blocks, and for fire-proofing against columns the best practise is to use from 2 to 4 ins. of terra-cotta. He had found the hard terra-cotta blocks hard to cut and easily broken, and would under some circumstances prefer the porous terra-cotta, though he did not consider them so strong as the hard. For protecting the lower flange of the beams, he considered that a slipper 1 in. thick was less apt to give trouble than the forms in which the springing block was molded to fit under the flange of the beam.

A Boston architect who has been identified with some of the largest buildings throughout the country, but who prefers not to have his name appear, was quite emphatic in the expression of his opinion in regard to the absolute merits of terra-cotta as a fire-proofing medium, which, in his judgment, amply meets all requirements and can be fully depended upon to resist the action of both fire and water. This architect, in his practise, makes it a custom to use for floor arches terra-cotta blocks which are the full depth of the beams. If a 10 in. beam is used a 10 in. block is specified, and if a 15 in. beam is required a block is made of corresponding depth lapping 1 in. under the flange of the beam, thus leaving 1 in. above the blocks below the tops of the beams, which space is filled in solid with cement concrete. If a wooden flooring is to be used, a 2 in. underfloor is then dogged directly to the iron beams, above which is laid the finished floor. In this way the steel work is thoroughly protected on the sides and the bottom flange, and he believes that no fire would ever work through 3 ins. of solid wood to get at the upper flange of the beam.

Other interviews will be reported in the February number.— Ed.

Mortar and Concrete.

AMERICAN CEMENT.

BY URIAH CUMMINGS.

CHAPTER VII.

CEMENT TESTING.

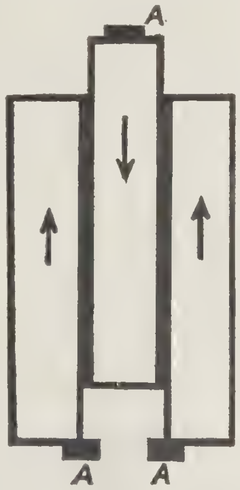
(*Continuation of tests made by Prof. Cecil B. Smith.*)

SERIES IV.

SHEARING TESTS.

THIS series of experiments was carried out with a view of obtaining more information on the shearing strength of mortar. The method adopted was as follows:—

Three bricks placed as shown in sketch were cemented together, and tested at the end of one month. It was found that by placing pieces of soft wood at *A*, *A*, *A*, an action as nearly as possible a shear was obtained, and gave very satisfactory results, the pressure being practically concentrated along the two mortar joints. No side pressure was applied, because the desire was to obtain minimum results where friction was not assisting.



The combined effect of adhesion and friction can easily be computed if the adhesion and superimposed load are known.

The results are divided into lime-mortar, natural cement mortar, and Portland cement mortar, also into ¼ in. and ½ in. joints, also into flat common unkeyed bricks and pressed Laprairie brick keyed on one side. (1) The lime mortar was mixed 1 lime to 3 of standard quartz sand, by weight; (2) natural cement mortar was mixed, 1 of No. 2 natural cement to 1½ standard sand; (3) Portland cement mortar was mixed, 1 of No. 5 Portland cement to 3 standard sand. (See exhibits of bricks with mortar attached.) The test pieces were chiefly allowed to stand in the laboratory at a temperature of 55 to 65 degs. Fahr., but one set of natural cement mortar and two of Portland cement mortar were duplicated by immersing in water for 29 days, after setting in air 24 hours before submersion.

These results point out many interesting facts: (*a*) the first fact noticeable is that the results are independent of the *thickness* of joint; this is true of lime and cement mortars. (*b*) The next one is not evidenced to any extent in the table, but was quite apparent in the testing, viz., that the adhesion of the mortar to the brick was greatest when the mortar was put on very soft, and least when the mortar was dry. This will largely uphold the use of soft mortars by masons, albeit their reason is a purely selfish one, the mortar being easy to handle. The tensile tests of cements made *very* soft are lower than when the mixture has the minimum amount of water for standard consistency. But for adhesive tests the case is evidently the reverse. It may be here mentioned that in these tests all bricks were thoroughly soaked with water before the joints were laid. (*c*) Coming now to the tests on lime mortar, the shears were through the mortar, except in the fourth experiment, and therefore they are quite independent of the key of the pressed brick on the surface of adhesion. This would point out the fact that keyed brick are superfluous in lime mortar joints, and the shearing strength per square inch averages about 10½ lbs. per square inch. The tensile strength of the same mixture at the same age was 30 lbs. per square inch, and the compressive strength 102 lbs. per square inch. (*d*) The natural cement mortar showed distinctly that its adhesive strength was not as great as its shearing strength, which is the reverse of the lime mortar tests. It also showed that the keyed brick aided in some unknown way, for the results on them are three times as great as with the common flat brick. Of course this may have been, and probably was, partly due to the different surface of adhesion. In five tests out of twenty-one made on the natural cement mortar, the mortar sheared through, and the average of these five was 97 lbs. per square inch, which gives the shearing strength proper, while the average adhesive strength of the thirteen tests in air which came loose from the bricks was 26 lbs. per square inch in common brick, 48 lbs. per square inch on Laprairie pressed brick, and 38 lbs. per square inch on Laprairie pressed brick for three tests submerged in water for the whole period.

This would show that the adhesive strength is nearly twice as great on pressed brick as common brick, and that submersion in water had a rather harmful effect than otherwise on the adhesive strength, and was certainly of no benefit.

The tensile strength of the same mortar at the same age was 132 lbs. per square inch; the compressive strength was not obtained, but would have been about 1,000 lbs. per square inch. The hints to be taken from these tests are that pressed brick keyed on both sides will give much higher results than flat common bricks, and would probably place the shearing strength of such joints at 100 lbs. per square inch, and make it largely independent of the consistency of the mortar. Also that the shearing strength is very much higher in proportion to the tensile strength than was the lime mortar shearing strength to its tensile strength, but about the same proportion to its compressive strength, *i. e.*, 10 to 1.

It becoming evident that the thickness of joint had no appreciable effect, the Portland cement mortar tests were made all ¼ in. thick.

TABLE VI.

TABLE OF SHEARING TESTS, OR MORTAR ADHESION TO BRICK SURFACES (in shear.)

Series IV.

Kind of Mortar.		Joint.	Brick.	No. of tests.	How indurated.	Shear in lbs. per square inch. Average.	Least.	Greatest.	REMARKS.
Lime 1.	Sand 3.	¼″	A	5	in air.	9.7	8.4	11.9	All sheared through the mortar.
Lime 1.	Sand 3.	½″	A	4	in air.	12.1	6.1	19.8	All sheared through the mortar.
Lime 1.	Sand 3.	¼″	B	5	in air.	12.0	9.1	15.5	All sheared through the mortar.
Lime 1.	Sand 3.	½″	B	5	in air.	8.0	5.5	11.0	All came away from brick (mortar dry).
No. 2.									
Natural Cement 1	Sand 1½.	¼″	A	5	in air.	22.3	8.0	32.1	All came away from brick.
Natural Cement 1	Sand 1½.	½″	A	5	in air.	29.0	24.0	33.0	All came away from brick.
Natural Cement 1	Sand 1½.	¼″	B	5	in air.	75.0	25.0	118.0	Two came away from brick, three sheared
Natural Cement 1	Sand 1½.	½″	B	3	in air.	85.0	43.0	118.0	One came away from brick, two sheared.
Natural Cement 1	Sand 1½.	½″	B	3	in water.	38.0	34.0	42.0	All came away from brick.
No. 5.									
Portland Cement 1	Sand 3.	¼″	A	3	in air.	10.6	10.2	11.6	All came away from brick.
Portland Cement 1	Sand 3.	¼″	A	3	in water.	13.0	10.2	16.4	All came away from brick.
Portland Cement 1	Sand 3.	¼″	B	3	in air.	16.5	9.2	24.2	All came away from brick.
Portland Cement 1	Sand 3.	¼″	B	3	in water.	27.1	20.2	36.9	All came away from brick.

The brick which was on top in [illegible] laying, always [illegible] first and at a [illegible] than that of lower one, which, of course, set under twice as much load or pressure.

A. Common, flat, unkeyed, salmon brick.
B. Laprairie pressed brick, key on one side.

The results are surprisingly low. The adhesion on the common brick is about the same for air drying or submersion in water, and is slightly less than one half that of natural cement mortar tests of 1½ to 1. This is a significant fact, for while a neat tensile test of No. 2 natural cement 4 weeks old is 268 lbs., the No. 5 Portland is 459 lbs. for the same age, and a 3 to 1 No. 5 Portland is 82 lbs. for same age. (See table of general laboratory results.) Thus while any test of this cement would show that a 3 to 1 mixture of the latter would be nearly equal to a 1½ to 1 test on the former, yet in their adhesive properties to common brick the heavily dosed sand mixture was only half as strong as the natural cement mortar with a smaller dose of sand. We might easily have expected this; but the main point is: is it taken account of, in considering the comparative values of these mixtures, that the adhesive strength of a Portland cement mortar heavily dosed with sand is low as compared with a weaker but richer mixture of natural cement mortar? The shearing of Portland mortar shows that the adhesion to pressed brick is greater than to common brick, but not in such proportion as in natural cements, being 1½ or 2 to 1 in place of 3 to 1 in the latter. But here again comes out the advantage given to Portland cements by testing them under water; the submerged specimens are stronger than open air ones, while in natural cements the reverse is the case.

Table VI. summarizes the results obtained.

SERIES IV. (*A*)

THE STRENGTH OF MORTAR IN COMPRESSION IN BRICK MASONRY.

All engineers realize that the strength of mortar is much less tested in cubes than in thin layers, but just what proportion they bear to one another is not very well known. The following experiments have been made with a view of obtaining this information. (See table VII.).

At the same time that these tests were made, mortar was also made into test pieces, and tested at the same age. We are thus enabled to form an idea of the relative strengths of mortar in thin joints and in cubes, and also to form an intelligent opinion of the comparative strengths of lime mortar, natural cement mortar, and Portland cement mortar. The mortars of the fourth, fifth, and sixth tests are identical with the mortars of the *shearing* tests, and show the same clear superiority of the natural cement 1½ to 1 over the Portland cement 3 to 1 when used in this manner. Table VIII., summarizes the results obtained.

Roughly speaking, the lime mortar at 1 week 5 to 1 is 6 times as strong; the lime mortar at 1 week 3 to 1 is 14 times as strong; the natural cement mortar at 1 week 1½ to 1 is 4 times as strong; the Portland cement mortar at 1 week 3 to 1 is twice as strong, as the same mortar tested in cubes, at the same age.

Referring to the amount of compression in Table VII., it will be seen that the amount of compression per foot is much less according as this ratio is less; *i. e.*, the less yielding the mortar, the nearer does the strength in cubes approach to the strength in joints. This is to be expected, because the more yielding substances will be at a much greater disadvantage when unsupported at the sides than if enclosed in a thin masonry joint.

In the second, third, fourth, and sixth tests at 17,500 lbs., the load was released, and the permanent set observed was as given in the fifth column of the preceding table.

It seems probable from this, therefore, that the lime mortars must have yielded to an injurious extent before there were any external signs. But whether this was the case or not, it is impossible

TABLE VII.

MORTAR JOINTS IN COMMON BUILDING BRICK PIERS.

Composition of Mortar.	Age of Test.	Thickness of Joints.	Dimensions of Brick Pier.	Per cent. water in mortar.	Loads in lbs. per square inch. 1st signs of failure in mortar.	1st signs of failure in brick.	Bricks failing rapidly.	Maximum load.	Compression per foot under a total load of 5,000	20,000	38,000
No. 1. 1 Lime. 5 Building sand.	1 week.	3/16"	7.80" by 7.85". 16.57" high. 6 bricks. 61.2 sq. in. area.	37 (?)	245	327	980	1,143	.015"	.08"	.13"
No. 2. 1 Lime. 5 Building sand.	3 weeks.	3/16"	8.0" by 8.0". 11.16" high. 4 bricks. 64.0 sq. ins.	37	469	563	1,406	1,553	.007"	.043"	.075"
No. 3. 1 Lime. 5 Building sand.	3 weeks.	3/16"	7.9" by 7.9". 24.50" high. 9 bricks. 62.4 sq. ins.	37	400	689	897	1,282	.005"	.053"	.094"
No. 4. 1 Lime. 3 Laboratory sand.	1 week.	1/4"	7.75" by 7.85". 11.42" high. 4 bricks. 60.84 sq. ins.	34	287	575	. . .	1,117	.032"	.133"	.158"
No. 5. 1 of No. 2 Natural cement. 1½ Lab'tory sand.	1 week.	1/8"	7.80" by 7.90". 11.15" high. 4 bricks. 62.01 sq. ins.	22½	968	1,190	1,403	1,984	.009"	.027"	.054"
No. 6. 1 of No. 5 Portland cement. 3 Laboratory sand.	1 week.	1/4"	800" by 7.95". 11.30" high. 4 bricks. 63.60 sq. ins. area.	20	755	959	1,305	1,564	.007"	.007"	.019"
No. 7. 1 No. 5 Portland. 1½ Lab'tory sand. Common building bricks.	1 week.	1/4"	8.00" by 8.00". 11.5" high. 4 bricks. 64.0 sq. ins. area.	20	1,125	1,563	....	1,734	.000"	.0045"	.011"
No. 8. 1 No. 11 Portland. 1 Lab'tory sand. Laprairie pressed brick.	12 days.	1/4"	8.3" by 8.3". 11.8" high. 4 bricks. 68.9 sq. ins. area.	....	1,679	1,800	1,930	1,960	.001"	.006"	.011"
No. 9. 1 Lime. 3 Lab'tory sand. Laprairie pressed brick.	4 weeks.	1/4"	8.2" by 8.2". 11.5" high. 4 bricks. 67.2 sq. ins. area.	35	260	853	....	1,263	.048"	.115"	.156"
No. 10. 1 No. 2 Natural. 1½ Lab'tory sand. Laprairie pressed brick.	4 weeks.	1/4"	8.4" by 8.4". 11.0" high. 4 bricks. 70.6 sq. ins. area.	22½	1,345	1,629	1,746	1,983	.000"	.0027"	.005"
No. 11. 1 No. 5 Portland. 3 Lab'tory sand. Laprairie pressed brick.	4 weeks.	1/4"	8.4" by 8.4". 11.1" high. 4 bricks. 70.6 sq. ins. area.	20	1,204	1,600	1,629	1,785	.002"	.011"	.016"

NOTE:— These results were obtained after the publication of the paper, and are the additional pier tests promised in the text.

to say, because the compression was quite uniform up to and in many cases much past the points of evident failure.

TABLE VIII.

	Strength of Mortar per square inch.			Loads released at 17,500 lbs., set observed per lineal foot.	
	In joints.	In cubes.	In tens'n.		
(1)	245	40	17	....	1 week old, mortar, 1 lime, 5 sand.
(2)	469	57	20	.01"	3 weeks old, mortar, 1 lime, 5 sand.
(3)	400	57	20	.03"	3 weeks old, mortar, 1 lime, 5 sand.
(4)	287	21	....	.08"	1 week old, mortar, 1 lime, 3 sand.
(5)	968	250	....	....	1 week old, mortar, 1 Natural Cement, 1½ sand.
(6)	755	341	43	.00	1 week old, mortar, 1 Portland Cement, 3 sand.

It seems fair to suppose that 1 week and 3 weeks are about the minimum and average times which would elapse before the maximum load might be put on a brick wall, and when it is remembered that

these joints were less than ¼ in. thick, the amount of compression in a high brick wall under a load of 80 or 90 lbs. per square inch is seen to be very great, and under a load of 300 to 400 lbs. per square inch, a brick wall 50 ft. high in lime mortar would not only fail, but compress from 2 to 6 ins. in doing so — the compression practically all taking place in the mortar, as in the unyielding Portland cement mortar the compression is seen to be very small.

The second part of this paper will contain tests made on piers built with pressed brick, in which the mortar has had longer time to harden, and interesting results are looked for.

The brick in this case was, as mentioned in Table VII., common building brick. The photograph given illustrates the method of testing and the interesting manner of failure of fifth test, in which the lines of least resistance are clearly defined.

(*To be continued.*)

AN architectural contemporary announces that a fair porportion of iron in a mortar makes no difference in regard to the durability of the latter. Within certain limits that is perfectly true; but the investigator might have added that durability is not everything. Bricks are frequently blamed for being "streaky," and it would be found in most cases that this appearance is due to the iron in the mortar. The sand used commonly contains minute grains of iron in a condition to be readily oxidized, unless closely imprisoned within the mortar. On weathering, these may not impair the durability of the cementing material as a whole, but they induce disfigurement on the surface of the brick.—*Exchange.*

LIME, HYDRAULIC CEMENT, MORTAR, AND CONCRETE. I.

BY CLIFFORD RICHARDSON.

THE FOUNDATION OF CEMENTS. The foundation of all cements, except those of a bituminous nature, which are used for binding together materials in masonry and concrete, is lime, the oxide of the metal calcium, which, although never found in the free state, is, in its various combinations, so widely diffused in nature.

OCCURRENCE. It occurs as carbonate in marble, in limestone, in chalk, in marl, and in shells, as sulphate in gypsum, as silicate in many minerals and rocks, and as phosphate in a few.

FORMS OF IMPORTANCE. Carbonate of lime in its purer forms and, when mixed with clay, in argillaceous or hydraulic limestones and some concretions, is of the greatest importance to the engineer and builder. From those forms in which there is but a small admixture of other substances lime is made. From those which contain clay or from a mixture of the pure carbonate with clay, hydraulic lime and cement are made.

CAUSTIC OR QUICKLIME.

The product of the expulsion of carbonic acid from the purer forms of carbonate of lime at a red heat is caustic or quicklime. It is the more or less pure oxide of the metal calcium, of which it contains about 95 per cent. when of the best quality.

The process of making lime in this way is called lime burning. It is conducted in kilns of various forms in which a suitable temperature can be maintained.

LIME KILNS. The kilns in use in lime burning are of both the intermittent and continuous types, and these again may each be divided into two classes, one in which the fuel is mixed with the limestone, the other where the combustion is carried on in a separate chamber or furnace, apart from the stone.

Whatever the method of burning, the product is much the same, the advantage of one form over another being purely one of economy of fuel and completeness and regularity of burning. In the United States almost all the lime burning is done in kilns of the continuous type, with the fuel, either coal or wood, mixed with the stone. Wood is supposed to produce a better lime, as the ash is smaller in amount and not so silicious. Where fuel oil, or gas is available, one of these sources of heat is the most satisfactory for lime burning.

LIME BURNING. Lime burning consists of raising limestone to that temperature at which it will lose its carbonic acid. It is usually carried on at a bright-red heat or about 1,700 degs. Fahr., although carbonate of lime begins to decompose at a lower temperature. Too high a temperature is undesirable, as this may produce a chemical combination between the lime and the impurities which all limestones contain to a greater or less degree. If these impurities are silicious, silicates of lime are formed which fuse and prevent the lime from slaking properly. The formation of such silicates may also take place with the ash of coal. This is known as clinker and is carefully thrown out in drawing the lime from the kiln. Smaller particles, however, cannot be separated and injure the quality of the lime.

It is necessary that a current of air should pass through the kiln, when lime is burned, to carry off the carbonic acid, as carbonate of lime, when heated in a vessel from which the gas cannot escape, is not decomposed and no lime is formed. A current of steam is even more desirable than air, but this is never used in practise, as it is hardly economical. The limestone is, however, often sprinkled with water which has, to a small degree, the same effect.

SOURCES OF LIME.

Limestone and marble are the usual sources of lime, but it can also be made from chalk, some marls, and oyster shells. Chalk is not found in this country, marl is used only for Portland cement, and

oyster-shell lime principally for fertilizers and purifying gas. Stone lime is preferable for building purposes to any of the other forms.

CHANGES IN LIMESTONE IN BURNING.

The changes which a limestone undergoes in burning are loss of weight by the removal of carbonic acid, water, and organic matter if present; change of volume, of density, of color, and of hardness.

Massive limestones, or marbles such as are used in making lime, have a specific gravity and density of from 2.65 to 2.75. Lime in the form of the stone from which it is made, that is, in lumps, is porous owing to the loss of carbonic acid and water. It has, therefore, a density of only 1.5 to 1.85, although the specific gravity of the lime is usually about 2.8 to 3.1, and that of the pure oxide 3.16.

The color of many limestones is due to organic matter which burns away and leaves the caustic lime white. If it does not burn away it is due to mineral impurities which are undesirable.

The hardness of lime is of course inferior to that of the stone from which it is made owing to the porous condition in which it is left, and there is a slight increase in volume due to the expansion of the gas in the stone.

From pure carbonate of lime exactly 56 per cent. of oxide or caustic lime should be obtained, but owing to the loss of water and organic matter, as well as carbonic acid and to waste, this figure is never reached except when there are admixtures of clay or silica. Then the loss of carbonic acid is not as great as from pure carbonate of lime. When the limestone contains much carbonate of magnesia the product of burnt lime may be considerably reduced, as this carbonate contains more carbonic acid than carbonate of lime. Such a limestone is known as dolomite and is of inferior value for making lime.

COMPOSITION OF LIMESTONE.

The ordinary marbles and limestones available for burning are never entirely pure. They contain a greater or less admixture of carbonates of magnesia and iron, of clay, and other silicates, of silica, of alkalies, of organic matter, and of sulphates, phosphates, and pyrites.

The following analyses are typical of the variations found in their composition.

ANALYSES OF LIMESTONE.	Carbonate of Lime.	Carbonate of Magnesia.	Iron and Aluminum.	Silica and Silicates
No. 1 White Marble, Maryland,	97.2	1.0	.6	1.0
No. 2 Blue Limestone, Maryland,	96.0	.5	1.9	1.8
No. 3 Silicious Marble, Maryland,	81.8	.8	.9	17.2
No. 4 Dolomite Tompkins Cove, N. Y.	53.8	41.2	.7	2.6
No. 5 Hydraulic Limestone, Maryland	57.9	3.0	4.9	20.4

Effect of Impurities. We find limestones which are nearly pure, having 97.2 per cent. of carbonate of lime, in the form of white marble, and 96.0 per cent. in a blue limestone. In contrast are stones which contain silica or clay as well as silica, as shown by the presence of iron and aluminum, and those which are mixed with carbonate of magnesia. All the forms have their peculiar properties. The purest should be, of course, selected for lime burning. The impurities in a limestone have an important influence on the character of the caustic lime made from it. A quicklime prepared from a limestone comparatively free from impurities and consequently nearly pure calcium oxide is called a rich or fat lime. With the increase of admixture of other substances the lime becomes poor, that is to say, it does not slake easily, and when this exceeds 10 per cent. the burnt stone begins to slake with more difficulty or fails to do so at all, and can be no longer regarded as a mere lime, but is hydraulic or magnesian lime depending upon whether the admixture is clay or carbonate of magnesia. Already with from 5 to 8 per cent. of clay in the limestone, the lime has hydraulic properties, and these increase until it is very highly hydraulic with 25 per cent.

When the admixture is magnesian and the rock is composed of carbonate of lime and magnesia, without clay, the resulting lime does not attain hydraulic properties, but merely becomes poor and fails to slake readily. With even 10 per cent. of magnesia, lime becomes poor, and with a larger amount still more unsatisfactory. Lime from dolomite, or magnesian limestone, which is very common in the United States, contains about 21 per cent. of magnesia, and is of inferior value for building purposes. Too much of this lime is used in the country, and it should be avoided as far as possible under all circumstances.

Lime containing a large amount of magnesia, if free from im-

Requirements for American Portland for coast Fortifications, U. S. Government.	Fineness through No. 50 sieve.	Fineness through No. 100 sieve.	Fineness through No. 200 sieve.	Tensile strength 1 in. Briquettes, neat, 24 hours in air.	Tensile strength 1 in. Briquettes, neat, 24 hours in air, and 6 days in water.	Tensile strength 1 in. Briquettes, neat, 24 hours in air, and 27 days in water.	Tensile strength 1 in. Briquettes, 1 cement, 2 sand, 24 hours in air, 6 days in water.	Tensile strength 1 in. Briquettes, 1 cement, 2 sand, 24 hours in air, 27 days in water.	Tensile strength 1 in. Briquettes, 1 cement, 3 sand, 24 hours in air, 6 days in water.	Tensile strength 1 in. Briquettes, 1 cement, 3 sand, 24 hours in air, 27 days in water.	Hot water tests.
At mouth of Cape Fear River, N. C.	99%	90%	70%		500 lbs.	600 lbs.	175 lbs.	250 lbs.			Briquettes 24 hours in air, 24 hours in water 212° F.
At Sandy Hook, N. J.				250 lbs.	450 lbs.				125 lbs.	200 lbs.	
Tybee Island, Ga.	100%	90%							125 lbs.	200 lbs.	Pats 24 hours in air, 3 hours in water 212° F.
Sullivan Island, S. C.		85%		200 lbs.	375 lbs.	500 lbs.			125 lbs.	175 lbs.	
Sheridan's Point, Va.	95%			175 lbs.	375 lbs.						After 24 hours, immersion in water 212° F.
Galveston, Texas.	95%			75 lbs.	300 lbs.	400 lbs.					
Gull Island, N. Y.	95%			75 lbs.		400 lbs.					
Key West, Fla.	96%	90%	70%	125 lbs.	400 lbs.	500 lbs.	150 lbs.	200 lbs.			Briquettes 24 hours in air, and 24 hours in water 212° F.
Dutch Island, R. I.	95%	77%		250 lbs.	400 lbs.	600 lbs.			125 lbs.	200 lbs.	
San Diego, Cal.				200 lbs.	450 lbs.	700 lbs.					
Portland, Me.	95%			150 lbs.	380 lbs.						
Portsmouth, N. H.	95%			175 lbs.	400 lbs.						

purities, may be used, however, for furnace linings as it resists heat well and is very basic, not fusing as readily as pure lime in presence of silica.

COMPOSITION OF CAUSTIC LIME.

The composition of commercial quicklime is varied, depending on the kind of rock from which it is made. The following are analyses of some typical limes, found in our markets:—

ANALYSES OF CAUSTIC LIME.

No.	Source.	Lime.	Magnesia.	Iron oxide and alumina.	Silica and silicates.	Loss on ignition.
1	New York from limestone .	95.6	.6	.8	1.2	1.0
2	Baltimore Co. from marble . .	95.3	.8	.9	2.2	.7
3	Washington, D. C. from dolomite .	73.3	21.4	4.0	.9	1.3
4	Connecticut from limestone .	85.1	5.7		2.8	6.3
5	Connecticut from dolomite .	55.3	36.4	3.2	1.4	3.7
6	West Virginia from limestone .	89.9	2.2	5.8		2.2
7	West Virginia from limestone .	74.2	2.4	1.5	3.9	17.9

It appears that limes which are 95 to 96 per cent. pure are the best that are attainable commercially and that they are frequently less pure. When fresh from the kiln lime would, of course, show no loss on ignition, but on storage it absorbs water with great avidity from the air until, as in that numbered seven, it has reached 17 per cent., when it is nearly half air slaked. Fresh lime, or that which has been carefully protected from the air, is of much greater value for building purposes, although too often this is unattainable.

UNIFORMITY IN CEMENT SPECIFICATIONS.

UNDER a clause in the bill making appropriations for the construction of gun implacements and fortifications, which passed Congress June 6, 1896, the cement used is required to be of domestic manufacture. The specifications of the various officers of the corps of engineers in charge of this work, as far as they relate to Portland cement, have been brought to our attention and are given in abstract in the table on opposite page.

As there has been considerable discussion recently in the journals of the engineering and allied professions in regard to uniformity in specifications for Portland cement, the very considerable variations in the above requirements is noticeable, especially as the work is all of one kind and to be done entirely by one organized body of men, who are supposed to represent the very highest standard in their profession. They are, nevertheless, not agreed as to what the requirements of a first-class American Portland cement should be or at least how its quality should be determined.

One requires a neat test of 75 lbs. in one day in air, another one of 250 lbs. under the same circumstances. The variations in the requirements for a neat test at the age of seven days are relatively less, lying between 300 and 500 lbs., but even these are large. At twenty-eight days the demand is for a very varying increase of strength over that at seven days, from 100 to 250 lbs. Two of the engineers require a test with two parts of sand, four a test with three parts, and six no sand test. As this is, perhaps, the most reliable test of Portland cement, it is remarkable that it should be omitted by half of those in charge of such improvements. Four officers require the boiling test, in three cases substituting it for a sand test.

It seems unfortunate, even if the large body of engineers of this country cannot agree upon specifications for hydraulic cement, that the Corps of Engineers of the United States Army cannot set a better example than appears in their recent specifications. It should be added, however, that the manufacturers of American Portland cement should, with the use of ordinary care, be able to meet the most severe of these requirements, and that some of them are too lenient.

The Masons' Department.

THE ARCHITECT AND CONTRACTOR—IN GENERAL.

BY THOMAS A. FOX.

(*Continued.*)

WHILE it is a comparatively simple matter to lay down the general principles which should govern the relations and dealings between the owner, architect, and contractor, the most valuable rules and suggestions, after all, come only with experience. In the case of extras, for example, the results of laxity of method and delay of settlement are so trying that one severe experience is usually sufficient to prevent a reoccurrence of such difficulties. It is hardly necessary to call attention to the fact that, as the settlement for extra work or work omitted is necessarily made at the close of a building operation, it is greatly to the advantage of the architect and contractor to be in a position to close the transaction without friction or disagreement with the owner, whose most lasting impressions of a given piece of work are generally those associated with the final dealings. When differences arise during the progress of construction, the architect or contractor, if they are right, usually have the opportunity to prove their case from subsequent developments; or if there is an honest disagreement, the architect or contractor, as the case may be, can show that, although his judgment may have been at fault, his intentions were of the best, and under such conditions the offense is usually forgiven or forgotten; but let there be a serious breach at the close of a building operation, and it is almost impossible to convince an owner that he is being fairly treated, and it is quite improbable that he would, under these conditions, give the architect or builder an unqualified indorsement to enable either of them to get future work.

Early in this consideration of the relations between architect and contractor, attention was called to the fact that the ability to carry out a large building project successfully depended more on the individuals than on any hard and fast rules which can be formulated, and that a thorough knowledge of the rights of the contractor as well as those of owner should be understood and recognized by the architect. Much of the trouble between the architect and his client arises from the fact that the latter usually assumes, unless he is told to the contrary, that it is the duty of the architect to always take sides with the owner in any controversy as against the contractor. This idea, which is more common than one would suppose, and is even held by some of the narrow-minded members of the profession itself, doubtless arises from the fact that as the architect is paid by the client, he considers that he has retained a professional adviser, under practically the same conditions as he would retain a lawyer to defend a case in court. This, however, is not the position in which a conscientious member of the profession should allow himself to be placed, and before undertaking a commission from a client who has not had experience, this relationship is a matter which should be fully explained and understood. Probably, if the truth was told, the architect who claims that he holds the autocratic position of counsel for the owner would be forced to admit that such an attitude was necessary for his own protection, for the same reason that a certain architect was fond of asserting that no client employed by him ever had to pay for an extra, the simple fact being that this architect never approved such an item on a bill, although the plans and specifications coming from his office were at least no better than those from many others who made no pretense to such infallibility. This architect, judging from the highest standard of professional practise was no more just than one who went to the other extreme, and accepted commissions from the contractor, which of course in the end are paid by the owner. It has already been stated here that the responsibility for the abuses which lead to the most serious controversies in connection with building operations are about equally divided between the different parties concerned; but naturally the architect, while trying to

assume an impartial position in the matter, but at the same time anxious to raise the standard of professional practise, may give a stronger emphasis to the shortcomings of his associates than to others equally responsible. But it must be admitted that the greatest responsibility in the effort to reform the abuses, to which attention has been called in these papers, must, from the nature of things, rest upon the architect, and if he can acquire a reputation for possessing a thorough knowledge of the various requirements of his profession, and at the same time that of dealing honorably and justly with his client on the one hand and the contractor on the other, he will soon find himself in a position where he need employ only those in whom he has strict confidence, and will seldom, if ever, be forced by his client into accepting any one to perform work who will not of his own volition carry out the proposed work according to the terms of the agreement. A prominent lawyer once defined a contract as an agreement between two honest men. The bitter competition which has been found of late years among all professions and trades has naturally tended to lower the standard of business integrity; but in spite of this, and probably to the end of time, no matter what may be the position of the employer, in a vast majority of cases he prefers to hire to perform his work only those whom he is sure will live up to the terms of an agreement; and although success may come more rapidly in some instances to those who are willing to take undue advantage of their fellow men, it will not, in the long run, be as satisfactory, as substantial, or as great, as to those whose word is as good as their bond.

(*To be continued.*)

INQUIRY AND REPLY.

SHOULD lime be used in mortar to prevent freezing?

H. S. M., Kansas City.

No. On the contrary, lime delays setting, and is of no advantage.

Is the subject of a better grade of mortar, or a more liberal use of cement in masonry construction, being given due attention by architects and builders? or is the strength of bonding of secondary importance?

R. H. Meyers, St. Louis.

The arguments which are of force in this case are the same as those for the use of high-grade materials of all descriptions which are to be used in any structural work. The entire structure cannot be stronger than its weakest part, so that poor cement and mortar make any superiority of quality of other materials of no value.

FROM OTHER COLUMNS.

OLD brick are being used instead of sand to make lime mortar, in the rebuilding of the new Union Station in Columbus, O. The refuse brick from the old walls are ground in a crusher. It is said that a quality of mortar for color work superior to that obtained with sand is produced.— *Eng. News.*

COST OF HAND AND MACHINE-MIXED CONCRETE. Machine-mixed concrete can be done at from one fourth to one third of the cost of hand mixing; at the same time the machine mixing is more thorough and economical. With a given amount of aggregate, from 10 to 20 per cent. less cement can be used without impairing the strength of the finished work.

The absolutely uniform results obtained by the best grade of machine mixers lessens the danger of cracks due to uneven setting, as the expansion and contraction of the mass will vary directly as the proportion of the cement varies throughout the mass.

Therefore there is not only a direct saving in the quantity of cement used, but also in the quality of the work as well as in the finish and lasting properties.

A new cement will contract and expand more than an old and stored cement.— *Cement.*

Recent Brick and Terra-Cotta Work in American Cities, and Manufacturers' Department.

CHICAGO.— No one expects extensive building operations this year, and yet architects and builders look for a fairly good business, notwithstanding the serious disturbances caused by election events, and more recently, the failure of some large banking institutions.

The list of projects announced looks well, although there is little of special importance.

Of the building that is to be done, architects are evidently desirous of having it done on a right basis.

Hopes often expressed in these columns in the past are being realized to the extent, at least, of a preliminary organization of architects, which has been lately effected. An Architects' Business Association has been formed, which aims to protect building interests against dishonest contractors, and the profession itself against unworthy members. It is earnestly to be hoped that an effective effort will be made to obtain legislation, giving the profession a legal status.

A local daily recently created quite a sensation by announcing in bold headlines, "It's a Leaning Tower," "Masonic Temple out of Plumb," etc. Having employed a surveyor to do some investigating,

TERRA-COTTA CAPITAL, BOWLING GREEN OFFICE BUILDING, NEW YORK CITY.
W. & G. A. Audsley, Architects.
Made by Conkling-Armstrong Terra-Cotta Company.

alarm was allayed by another headline in much smaller type, "It is Perfectly Secure, and no Importance is Attached to this Singular Deviation."

The Masonic Temple is a twenty-story building, about 170 ft. square, and the north wall, at a point 265 ft. above the ground, is 9 ins. out of the vertical. It is to be hoped that other buildings are in no more immediate danger than the Temple, but the unequal settlement of this important structure will serve as a text for discussion on "rigid joints," "the danger of cast-iron connections," etc.

In the list of buildings projected, Warren H. Milner, county architect, is planning various additions to the public hospitals, jail, and infirmary.

Perkins & Krause have two factory buildings, one 75 by 100 ft., seven stories, and the other, 50 by 100 ft., five stories high.

Cowles & Ohrenstein have in hand a store building 76 by 86 ft., four stories, and a warehouse.

An apartment building, designed by Mr. Fritz Foltz, is men-

tioned in which each suite has its bedrooms in the story above its parlor, kitchen, etc.

Some three hundred million common bricks were manufactured in and about Chicago during 1896. This is only one third of the capacity of our kilns, and but two thirds the production of the previous year. This fact in itself is significant as showing the condition of the building business during the year.

ST. LOUIS. — The new year has brought little of special interest in the building line. In fact, there is more or less disappointment among the architects and builders, as it was felt that by this time there would be considerable more work under way.

Capital seems very nervous, and as soon as one excuse has become worn another is found. There have been very few business failures in our city within the last year, and no banks, but the failures throughout the country have been a disturbing element in money circles and have caused the delay of some important building schemes, but as the year advances a steady improvement is noticeable.

There has been no time within the last several years when building could be done so cheaply as now. This presents an opportunity which is being taken advantage of by many, in building good residences in the more aristocratic neighborhoods, such as Westmoreland, Portland, and Bell Places, while the business depression has tended to diminish the number of cheap flats and building of houses for speculation.

Among the handsome residences just being completed is the Dozier residence in Westmoreland Place, by Architect F. L. Wees. The building is three story and basement, of brick and terra-cotta, in the French Renaissance, and will cost $75,000.

Architect W. A. Swasey is building another near by of white brick and terra-cotta, while further up the street he has just finished a large stone residence for Mr. B. Nugent, at a cost of $65,000.

In Bell Place, Architects Barnett, Haynes & Barnett have just finished two residences costing about $40,000 each, one in stone and the other in buff brick with white terra-cotta trimmings; while F. C. Bonsack is taking figures on a stone residence for Mr. G. W. Brown, to be built in Portland Place.

Architect Taylor has just completed a five-story building on Broadway, on the site of the old Aloe Building, which was the scene of a fatal fire about a year ago, in which several firemen perished. The front is of red terra-cotta with large plate windows on each story, making an ideal business building and a decided improvement over the old rookery that was destroyed.

The building of the St. Louis Dairy Company, occupying nearly half a block between 20th and 21st Streets, by Architect Swasey, is a very interesting piece of red brick and half-timbered work. The basement is occupied by the stables, wagons, etc., while the upper floors are used for the offices and laboratory.

There are a number of old landmarks in which the advancement of modern progress has made it necessary to make alterations. Among these the old Davis Building, for nearly a quarter of a century the home of the large wholesale house of Samuel C. Davis, is being transformed into a department store, by Shepley, Rutan & Coolidge, at a cost of $50,000.

A movement is on foot to provide some permanent place for large gatherings, conventions, etc., and Architect Ramsey has prepared plans for a large amphitheater to occupy the north end of the Exposition Building, with a seating capacity of about 8,000, and in case of conventions, by using the arena, as many as 14,000.

AN ENTRANCE IN TERRA-COTTA, UNION TRUST BUILDING, ST. LOUIS, MO.
Louis H. Sullivan, Architect.
The face and common bricks used in this building were furnished by the Hydraulic Press Brick Company, of St. Louis.

PITTSBURG.—The outlook in the architectural and building line for the coming season is very good. There is a movement well under way to erect a new Chamber of Commerce building at a cost of about $1,000,000. The Ninth U. P. Presbyterian Society of Allegheny are to erect a new church, to be of brick and stone, and cost about $20,000. Architect J. E. Allison is preparing plans for a new church of brick for the Methodist society of Vandergrift. Architect J. M. Alston has the new Insane Asylum for Allegheny City, which will be of brick. Architect Charles Bickel has the new German Turn Verein Building on South Side. Architect T. E. Cornelius is planning a small hotel for Coraopolis. Architect W. S. Sims has a fireproof laundry building on Fifth Avenue, Oakland; also a residence in the East End, each of which will cost about $20,000.

Mr. A. C. Boyd, of Boyd & Long, architects, died last month. Architects Shaw & Metcalf have dissolved partnership, Mr. Shaw continuing the business, and Mr. Metcalf returning to England.

Architects George Orth & Brother were successful in the completion for the new building for the Western Bank of Pennsylvania.

MINNEAPOLIS.—A number of interesting things have developed, and we feel confident for next season, but matters are quiet now.

Among other interesting reports is that of a new Chamber of Commerce, to cost $300,000, which is to be voted upon by the Chamber. They have secured an option on the corner adjoining the present building. This is an important and much-needed improvement, a number of the larger corporations being unable to find quarters in the present inferior building.

A very interesting and unusual experiment has been made by the New England Furniture and Carpet Company during the past year, which culminated New Year's night. They wished to observe the tenth anniversary of their beginnings in Minneapolis in a fitting manner, and conceived the idea of building a neat, roomy modern house in one of our best suburbs, and giving it away, free of cost, to the lucky holder of the ticket selected in an open and fair manner from those issued during the year to their patrons, every $25 purchase entitling holder to a ticket. The house was designed by one of our leading architects, and is a gem in every way. As usual, the

YERKES OBSERVATORY, GENEVA, ILL.

Henry Ives Cobb, Architect.

The buff brick used in this work was furnished by the Columbus Brick and Terra-Cotta Company, Columbus, Ohio. The architectural terra-cotta by the American Terra-Cotta & Ceramic Company, Chicago.

PORTION OF YERKES OBSERVATORY, SHOWING DETAIL.

winner was one of the smaller purchasers, holding but the one ticket, which was quite sufficient, of course. The lucky person was a lady who had purchased $27 worth of goods; a decidedly good investment, all things considered. The head of this company is a former Bostonian, Mr. W. L. Harris.

There has been considerable trouble and expense connected with the new electric plant and elevators at the Court House. An expert has carefully examined it and made an exhaustive report of his findings, but the elevator company does not take kindly to it naturally, and there is to be a joint investigation. Meanwhile, the service is unsatisfactory and the stairways are found safe and useful.

W. B. Dunnell has prepared plans for the new State Insane Hospital, to be built at Aroka, at total cost of some $900,000, one third of which will be required for a beginning.

The local G. A. R. posts have prepared a petition to our Park Commission requesting permission to erect a $35,000 building in Loring Park, to serve as headquarters and a museum for relics, etc.

The Regents of State University have asked the legislature for $100,000 to erect needed buildings during the coming two years: A chemical building this year, and for 1898 a fire-proof botanical building, a horticultural building, veterinary building and light and heating plant at State Farm.

NEW YEAR'S CALENDARS AND CATALOGUES.

To one who contemplates entering the clay-manufacturing business the new catalogue issued by the American Clay-Working Machinery Company, Bucyrus, O., will be found of invaluable assistance. There is a wealth of facts to be found from cover to cover, which seem to furnish all information upon the subject which could be desired. About every machine required in the manipulation of clay is illustrated and described; not only this, but the finished product itself as well as its application is shown in a most interesting series of illustrations. Such a work as this can be considered nothing less than an up-to-date journal of the industry it represents. Copies of this catalogue will be sent free on application to the company.

TERRA-COTTA DETAIL EMPLOYED IN GOODRICH HOUSE, TOLEDO, OHIO.
Coburn, Barnum, Benes & Hubbel, Architects.
Made by the Northwestern Terra-Cotta Company.

TERRA-COTTA CAPITAL, BOWLING GREEN BUILDING, NEW YORK CITY.
Made by the Conkling-Armstrong Terra-Cotta Company. An illustration of this building will be found in the company's advertisement, page v.

SAMUEL H. FRENCH & Co., Philadelphia, paint manufacturers and dealers in builders' supplies, have issued a most useful pad calendar, each leaf having a space for memoranda for every day in the week. A calendar of this sort once used becomes almost indispensable in office equipment.

MR. F. B. GILBRETH of 85 Water Street, Boston, has again issued his attractive calendar showing the time of tides. This, we presume, will not particularly interest our inland subscribers unless they are troubled with wet cellars.

THE "American Seal Paint" Calendar, issued by Wm. Connors, Troy, N. Y., in addition to the regular calendar features tells how "Uncle Sam" got his name, and shows his *modus operandi* of adding stars to the field of blue. The color scheme introduced is very attractive.

MR. F. W. SILKMAN, dealer in minerals, clays, colors, and chemicals, 231 Pearl Street, New York, has sent us a very handsome calendar, the top part of which has an engraving encircled by an embossed border, which adds much to the attractiveness of the whole. Each calendar has a different subject for illustration, which is taken from some well-known painting.

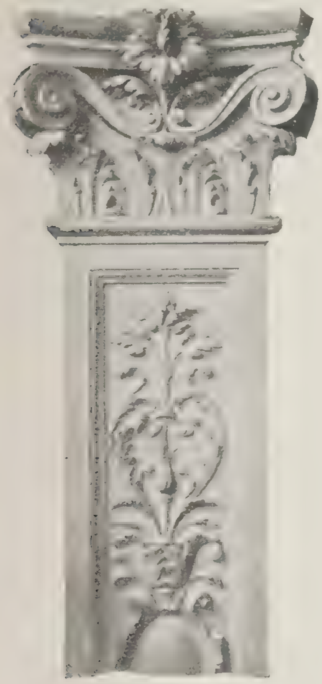
A NEAT little iron frame which has been treated by the Bower-Barff Oxidized or Rustless Iron Process holds the calendar issued by the L. Schreiber & Sons' Company, Cincinnati, to whom we are grateful for having remembered us.

R. GUASTAVINO has sent us a calendar which is interesting particularly because of the half-tone illustrations it contains, which show in a manner that almost explains his system, several of the prominent buildings wherein his fire-proofing tiles are employed.

NUMBER four of the series of "Minor Italian Palaces," which is being issued by the Cutler Manufacturing Company, Rochester, N. Y., contains seven plates from sketches made by Mr. Claude F. Bragdon, which, though grouped under the head of "Minor Italian Palaces," are nevertheless very interesting.

THE progress in material prosperity which this country has experienced during the past decade, no less than the increased possibilities of artistic manufacture, are well exemplified by the recently published Sketch Book of the Philadelphia and Boston Face Brick Company. This brochure contains over a hundred designs for fireplace mantels illustrated in greater part by photographic reproductions of actual work. The Sketch Book contains only fireplace

designs. They are well chosen, clearly and artistically presented, and offer a choice both in form and color suitable for a great variety of purposes. We may not habitually ascribe daintiness to such a material as pressed brick, but the brick forms are combined so cleverly that, especially in some of the smaller mantels, very dainty effects are produced; and though we might more naturally associate a brick mantel with a hall, a dining room, or a den, there are a number of photographs of charming mantels for parlors or boudoirs which leave little to be desired.



EXECUTED IN TERRA-COTTA FOR TREMONT TEMPLE, BOSTON.
Made by the Perth Amboy Terra-Cotta Company.

ALL THIS IS NEWS.

The Kittanning Brick and Fire Clay Company, Pittsburg, Pa., whose yearly output of front brick in all shades will exceed seven million, have contracted with Meeker, Carter, Booraem & Co., 14 East 23d St., N. Y., to handle their Eastern business.

Waldo Brothers, the well-known building material dealers of Boston, have leased on a long term the Tudor Wharf property at Charlestown. This splendid piece of water-front property will be fully equipped for the better handling of the concern's extensive business.

The Pennsylvania Enameled Brick Company has recently supplied forty thousand enameled bricks for the Third Avenue Bridge, at Harlem, N. Y., Isaac A. Hopper, builder; also twelve thousand of same for the Police Station and City Court Building at Yonkers, N. Y., Edward A. Forsyth, architect.

The Perth Amboy Terra-Cotta Company have just closed, through their agents, Waldo Brothers, the contract for the Proctor Building, Bedford Street, Boston, Winslow & Wetherell, architects. This is the most elaborate use of terra-cotta of any building scheme in Boston, the entire front being of terra-cotta from the sidewalk up.

G. R. Twitchell & Co., Boston, are supplying 100,000 red face brick for the new West End Schoolhouse, Boston, John Lyman Faxon, architect; Mead, Mason & Co., builders. Also 50,000 red face brick for the new schoolhouse, Dorchester district, Boston, E. W. Clarke, architect; W. S. Sampson & Son, Builders.

The architectural terra-cotta for the new building for Mt. Holyoke College at South Hadley, Mass., will be supplied by the Perth Amboy Terra-Cotta Company through their New England agents, Waldo Brothers. The plans are by Gardner, Pyne & Gardner, H. P. Cummings & Co., contractors.

In the reorganization of the Pennsylvania Enameled Brick Company, Seymour Van Santvoord becomes president; Henry Burden, 2d, vice-president; Wm. F. Burden, secretary and treasurer; Arthur E. Barnes, general manager; and F. P. Huston, New York representative. In addition to the manufacture of enameled brick, the company is now making a fine grade of white front brick.

The Perth-Amboy Terra-Cotta Company will furnish the architectural terra-cotta on the following contracts: St. James Office Building, Broadway and 26th Street, New York City, Bruce Price, architect, the details of which will be very elaborate; Bell Telephone Building, 11th and Filbert Streets, Philadelphia, Chas. McCaul, architect; Western Electric Building, southeast corner Bethune and West Streets, New York City, Cyrus L. W. Eidlitz, architect.

The Tiffany Enameled Brick Company will supply the enameled brick for the "Fair" Building, northwest corner State and Adams Streets, Chicago, Jenney & Mundie, architects; George A. Fuller Company, contractors; Sherry Hotel, southwest corner Fifth Avenue and 44th Street, New York City, McKim, Mead & White, architects; Richard Deeves & Son, contractors. This order calls for about 270,000 White English size enameled brick.

The Commercial Wood and Cement Company, through their New York office, 156 Fifth Avenue, have closed contract with J. L. Ginn, Philadelphia, for 21,000 barrels of Commercial Rosendale cement for gun emplacement at the United States Fort Caswell, at the mouth of the Cape Fear River, N. C.

They have also closed contract with the Hartford Paving Company, Hartford, Conn., for 10,000 barrels of Commercial Rosendale for the United States gun emplacement at Portsmouth, N. H.

EXECUTED IN TERRA-COTTA FOR TREMONT TEMPLE, BOSTON.
Made by the Perth Amboy Terra-Cotta Company.

The White Brick & Terra-Cotta Company, of 92–94 Liberty Street, New York, have just completed the terra-cotta for a candy factory, 84 to 90 Vandam Street, De Lemos & Cordes, architects; the Store Building, 78 Fifth Avenue, A. Wagner, architect; and Flushing Bank Building, at Flushing, L. I., S. E. Gage and W. J. Wallace, architects; and have closed contracts for residence at Bergen Point, N. J., A. F. Leicht, architect; chapel at Geneseo, New York, Heins & LaFarge, architects; and terrace for Tiffany residence at Westbury, L. I., W. J. Wallace, architect.

Mr. J. Francis Booraem, well known through his connection with the American Enameled Brick Company, has been admitted to the firm of Meeker & Carter, the new firm name becoming Meeker, Carter, Booraem & Co. The firm of Meeker & Carter is well known as being one of the largest operators in building materials in New York City, among the many manufacturers for which they are agents being the Staten Island Terra-Cotta Lumber Company, Woodbridge, N. J.; the Standard Fire-proofing Company, Perth Amboy, N. J.; Selden Brick Company, Erie, Pa.; Kittanning Brick & Fire Clay Company, Pittsburg, Pa.; Pennsylvania Brick Company, Oaks, Pa.; Williamsport, Brick Company, Williamsport, Pa.; Alumina Shale Brick Company, Bradford, Pa.; Garthe Roofing Tiles, Baltimore, Md.; American Enameled Brick & Tile Company, South River, N. J.; Farnley Glazed Bricks, Farnley, Leeds, England.

We are very glad to print the following letter, which will explain itself. Such testimony from a well-known architect will do much toward placing the American manufacture of enameled brick in a right light before our architects and builders.

ILLINOIS CENTRAL RAILROAD COMPANY.

OFFICE OF THE CHIEF ENGINEER.
CHICAGO, Dec. 14, 1896.

TIFFANY ENAMELED BRICK COMPANY, CHICAGO, ILL.: —

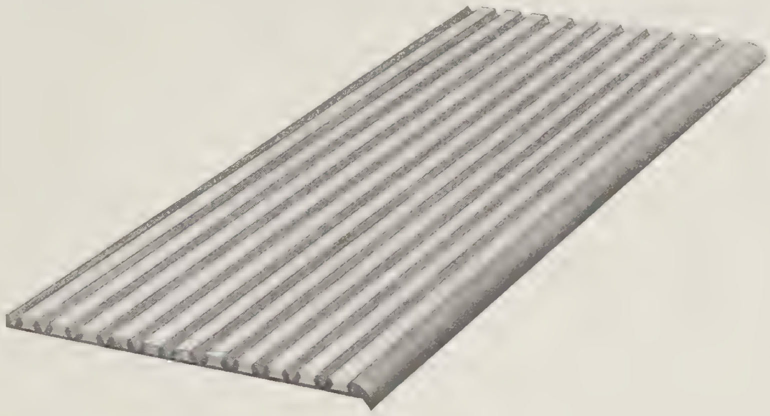
Gentlemen: Having thrown open to the public the underground suburban station at Van Buren Street, which is said in all respects to be a phenomenal success, I feel I must extend my thanks to some of the material men and contractors that so ably assisted me in its construction.

Your enameled brick (English size), which I used in this work, I have found are all you could possibly recommend them to be; and you deserve much credit from all, especially the architectural profession.

Not only are your brick very evenly enameled, and scarcely any difference in shade, but they are exceedingly hard, and I found could be perfectly ground for high-grade arch work, where I had to use some of them.

Taking pleasure in knowing that this lay-out at Van Buren Street Station, of your material, will be a great card for your firm, I remain,

Yours respectfully,
FRANCIS T. BACON,
Supervising Architect, Illinois Central Railroad Company.



SECTION OF MASON SAFETY TREAD.

DURABILITY AND SAFETY.

FEW building improvements in recent years have more quickly won deserved recognition from architects and builders than the Mason Safety Tread, which was introduced in Boston only about a year ago, and is now almost as well known as the Old South Church or the sacred codfish. The Mason Tread is a unique device, extremely simple and exceedingly effective. It is easily applied and adapted to a great variety of places, especially in our Northern climate, where stairs, entrances, and sidewalk lights are made slippery during so large a portion of the year by rain or snow.

The Mason Tread consists of a base of chilled steel with elevated ridges forming dove-tail grooves into which strips of lead are firmly pressed, the softer metal giving a sure foothold and the steel ensuring great durability.

The tread material is used in hundreds of places on our streets in the repair of worn Hyatt light borders, and the company is prepared to manufacture for new buildings sidewalk lights protected with their material. For internal use, Shepard, Norwell & Co. were among the first of our great retail merchants to appreciate the worth of the Mason Tread, and their grand staircase shows it to great advantage. Houghton & Dutton will have the stairways of their mammoth new building fully equipped with the treads, and in many other stores. In the Adams House and other principal hotels they are used upon stairways, entrances, and thresholds. They are used upon stairways in the City Hall, Quincy and Faneuil Hall Markets, Boston, upon the stone steps of all the police stations, and the company is at work upon a contract to place them upon the stairs in subway stations, where they will receive the severest test of all.

At the company's office, 40 Water Street, Boston, a sample stairway may be seen, showing the application of the treads to wood, iron, and marble. Mr. W. S. Lamson, of cash-carrier fame, is president of the American Mason Safety Tread Company, and Mr. Henry C. King, of Lawrence, treasurer. The factory is at Lawrence.

WANTED.

A FIRST-CLASS salesman in front brick and terra-cotta to sell goods in Massachusetts, Rhode Island, and Connecticut. Must have an acquaintance with the trade and a knowledge of figuring terra-cotta. Address C. S. S., Care of THE BRICKBUILDER.

INDEX TO ADVERTISEMENTS.

VOLVME VI FEB. 1897 No. 2

THE BRICKBVILDER

OFFICE 85 WATER STREET BOSTON

THE BRICKBUILDER.

AN ILLUSTRATED MONTHLY DEVOTED TO THE ADVANCEMENT OF ARCHITECTURE IN MATERIALS OF CLAY.

PUBLISHED BY

ROGERS & MANSON,

CUSHING BUILDING, 85 WATER STREET, BOSTON.

P. O. BOX 3282.

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PUBLISHERS' STATEMENT.

No person, firm, or corporation, interested directly or indirectly in the production or sale of building materials of any sort, has any connection, editorial or proprietary, with this publication.

THE BRICKBUILDER is published the 20th of each month.

IN our editorial column last month we took occasion to urge again the necessity of making common brick as well as pressed brick of the standard size, in order to do away with the unnecessary difficulties which the present unevenness of shape and improper proportions of most of the common brick put in the way of a general use of good bond in brickwork, and we pointed out that the reform we advocated would be certain to lead to a largely increased use of brick. There is a large field from which brickwork is now practically excluded, and in which it ought to be commonly employed, namely, our suburban architecture, and the practises we have been condemning are certainly among the causes which contribute to prevent the conquest of this important field by brick.

At the last monthly meeting of the Boston Society of Architects, Mr. Clipston Sturgis read a most interesting and suggestive paper in which he compared our suburban architecture, which is almost exclusively of wood, with recent suburban architecture in England, in which brick is generally employed. In the course of his paper he referred to the imperfect bonding of our brickwork, which must be improved if the use of brick is to become general, especially if 8 in. walls or hollow walls are used, which would be insecure unless thoroughly bonded. He emphasized especially the grave menace to the safety of all our great cities which exists in the easily inflammable wooden suburbs, by which they are on all sides surrounded. In these often large districts, more or less closely crowded with wooden buildings of the most inflammable character, a conflagration might start which the more solid masonry buildings in the heart of the city would be totally unable to resist. It is true that buildings in which the exterior walls only are of brick, and which have wooden floors and interior partitions, may easily be totally destroyed by fire, but it is a comparatively easy matter to prevent a fire in such a building from spreading to others in the neighborhood. It is true also that a conflagration of even limited extent will sweep away such buildings in its path almost as easily as if they were entirely of wood; but if *all* the buildings in a neighborhood had external walls of brick or other non-combustible material, no such conflagration would be likely to get under way. This is one reason why conflagrations are of so much less frequent occurrence in Europe than they are with us. It was shown that the expense of brick buildings need not be very much greater than those of wood. Moreover, if the use of brick was thus largely increased, brick would become still cheaper. The greatly increased demand would make it possible to sell bricks at a profit at prices much less than those which now prevail. Interior furring against brick walls can be done away with by using hollow-brick fire-proof furring blocks, which are now made of such a size that they can be bonded in with the brick. A very good wall is one built 8 ins. thick of brick, with a 1 in. air space and a 4 in. interior wall of fire-proof hollow bricks, bonded into the exterior wall. Such a wall has practically all the strength of a 12 in. wall, and is as dry as if furred on the inside with wood, especially if the air space is ventilated at the bottom into the celler, and at the top into the roof space, as can easily be done. Unfortunately, at present the building laws of Boston and some other cities make the use of hollow walls unnecessarily expensive by refusing to count the inner lining as part of the effective thickness of the wall, when yet, if properly bonded, such a lining adds materially to the strength of the wall. The additional cost of the brick is fully offset by the greater permanence of the structure, by the saving in painting and repairs, and by saving in the insurance. It is a great mistake to suppose, as is sometimes done, that it is to the advantage of underwriters to have buildings that will burn up. All the efforts of insurance people have tended the other way. In a district in which structures having exterior walls and roofs of non-combustible material are the rule, and not the exception, underwriters can and will give more favorable rates on such buildings than where they are surrounded by highly inflammable structures. External ornaments of wood must, of course, be avoided if the advantage of the brick wall in point of safety against fire is to be preserved. Such wooden ornaments are nearly always ugly and are always unnecessary, especially now that manufacturers of molded bricks place such a variety of designs at the disposal of the builder.

But beyond the important questions of durability and safety lies the question of beauty. The best design in wood cannot equal the effectiveness of a good brick design. The wood always has an unsatisfying appearance of flimsiness and want of permanence. But our average wooden suburban house is uglier than it need be, and most of our suburbs are hopelessly depressing in their commonplace and often complacent vulgarity. There is certainly no substantial foundation for the feeling that there is anything unsuitable in the use of brick in the country, the feeling which regards it as something belonging to the city. That feeling, when it exists, arises solely from our having been so long accustomed, in our new country, to houses of wood, which have naturally persisted longer in the country than in the cities. There is a satisfaction in the look of permanence of a good country house of brick, and the warm, soft colors of a well-built brick wall nowhere are so beautiful as in a house embow-

ered in trees. We do not need to go to Europe to discover this. The country districts of Maryland, and Virginia, and portions of Pennsylvania still have fine old county seats of brick whose grouped chimneys and substantial-looking walls are most pleasant objects in the landscape.

The time, we believe, is not far distant when more substantial methods of building in our suburbs will be insisted upon, and brickmakers may find this important field preoccupied by other methods if they do not bestir themselves. We believe these are matters to which architects have not given as much attention as they should, and they might exert a great and salutary influence for the improvement of our suburban architecture.

PERSONAL AND CLUB NEWS.

BENES & KUTSCHE, architects, Chicago, have removed from 63d Street to more spacious offices on the sixteenth floor of the Manhattan Building.

HARVEY L. PAGE AND STANFORD HALL, architects, have formed a copartnership under the firm name of Harvey L. Page & Co., with offices at Chicago and Washington, D. C.

MR. GODDARD has retired from the firm of Mills & Goddard, architects, Columbus, O., and connected himself with Peters, Burns & Pretzinger, of Dayton, O., as superintendent. Mr. Wilbur T. Mills will continue the business of the old firm.

THE new iron steamship being built by F. W. Wheeler & Co., Detroit, Mich., for the Bessemer Steamship Company, of New York, has been named by the owners the *W. L. B. Jenney*, as a mark of appreciation of the well-known Chicago architect's connection with the invention and introduction of lofty steel-skeleton construction of buildings.

THE exhibition of the Chicago Architectural Club has been postponed from March 2 to March 23. On the evening of February 15, Mr. George R. Dean, architect, read a paper on "The Evolutionary Position of American Architecture."

There were thirty-seven competitors this year for the Robert Clark Medal, the subject being "A Public Bath."

In awarding the silver medal the judges, Messrs. Louis J. Millet, Charles A. Coolidge, and J. K. Cady, were confronted with two designs of such nearly equal merit that they chose to make a new precedent and award two medals, one of which was their own contribution. The prizes were awarded as follows: Gold Medal, David G. Meyers, Boston, Mass.; Silver Medals, John F. Jackson, Buffalo, N. Y., and Oscar M. Hokanson, Philadelphia, Penn.; Bronze Medal, Arthur Shrigley, Lansdowne, Penn.; Honorable Mention, John F. Sheblessy and Thomas Livingston, Chicago, Ill.

THE regular monthly meeting of the St. Louis Architectural Club was held on the evening of February 6. President Ittner announced the committees and outlined the work for the year. Mr. Farish gave an interesting talk on "Cabinet Finish." A talk on "Hobos of the St. Louis Architectural Club in Rome," with lantern slides, was given by Mr. Fred Cox.

AT the regular monthly meeting of the Washington Chapter of the American Institute of Architects, held Jan. 8, 1897, the following officers were elected to serve during 1897: —

President, Joseph C. Hornblower; Vice-President, James G. Hill; Secretary, Edward W. Donn, Jr.; Treasurer, William J. Marsh; Committee of Admissions, Glenn Brown, W. M. Poindexter, J. R. Marshall. Mr. Eames, of Eames & Young, of St. Louis, was the guest of the evening. At the meeting held Friday, February 5, Mr. William Martin Aiken described the exhibition of the drawings of the American School of Rome, held in Philadelphia.

THE regular meeting of the New Jersey Society of Architects was held February 4, at the Board of Trade Rooms, Newark, N. J.

In an informal discussion regarding professional etiquette several instances of unprofessional practise were cited, and the practise of making promises to prospective clients which could not possibly be fulfilled were condemned. Several instances were cited in which the uniform contract between architects and owners, which was adopted some time ago by the society, were productive of much good in preventing misunderstanding with clients.

BOOK REVIEW.

HOW to Build a Home"[1] is the title of a small book by F. C. Moore, who, from his experience and long observation as president of a large fire insurance company, is so abundantly able to give good advice on such a subject that his suggestions are well worth study. The book is sensibly written, with an appreciation of practical requirements and a refreshing absence of mere theory, containing the sort of advice one would expect from a friend who had built a house and knew what not to do and how to avoid it. Most people who build a house for the first time, if they employ an architect at all, are quite likely to be a bit afraid of him and his alleged extravagances, and not knowing really what they want, are loth to admit the vagueness of their expectations. It is to such that Mr. Moore's book will prove a boon, as it will enable them to understand the architect's plans, and avoid at least some of the faults which are sometimes overlooked by the most competent experts.

[1] "How to Build a Home. Being suggestions as to safety from fire, safety to health, comfort, convenience, durability, and economy." By Francis C. Moore, President of the Continental Fire Insurance Company, New York. Cloth, $1.00; paper, 50 cents.

ILLUSTRATED ADVERTISEMENTS.

THE accompanying illustration shows the entrance to the Hamilton Club Building, Paterson, N. J., in which terra-cotta has been used with encouraging success from the level of the first story sill course. Mr. Charles Edwards is the architect, and the work was furnished by the New York Architectural Terra-Cotta Company.

In the advertisement of R. Guastavino, page xiv, is shown a

Guastavino System ceiling in one of the wards of the New Buffalo General Hospital, George Cary, architect.

In the advertisement of Charles T. Harris, Lessee, page xxvi, two views of the station for the Toledo & Ohio Central Railway Company, at Columbus, Ohio, are shown, Yost & Packard, architects.

F. B. Gilbreth, in his advertisement for this month, page xxxiv, illustrates the doorway of Casa de las Conchas, Salamanca.

Italian Towers, IV.

BY C. HOWARD WALKER.

THE previous articles have shown examples of the most characteristic towers of Italy, from the earliest fortification tower type to the elaborated colonnaded type, represented by towers such as those of Chiaravalle and S. Gottardo, at Milan. There remains, scattered over Italy, two other varieties, each much more easily classified under an architectural style than those already mentioned, and yet both much more lacking in what can be truly called style. They are the Gothic and the Renaissance towers. Omitting Giotto's tower, at Florence, which is individual and like no other tower in existence, the Gothic towers of Italy, that is, the towers that attempt Gothic elaboration, are not especially attractive. The style never thrived on Italian soil. There was too conspicuous an environment of classic precedent, and climatic conditions did not tend to produce or to find acceptable the high peaked roofs and large openings of what is essentially an architecture of the Northland, suited to rains, and snows, and gray skies. With the close commercial ties that Italy had with Germany, and also from the fact that German mercenaries and free-lances constantly formed an important factor in the martial forces of Italian cities, it was most natural that the art of both Germany and France should have some reflex influence upon Italian architecture; but although there are distinctly Gothic churches in Italy, such as the Cathedral of Orvieto, and of Siena, the style had undergone a very manifest change, and instead of being sturdy, vigorous, expressing constructive conditions, and rich with masses of light and shades, its forms had become flattened, its constructive expression disappeared, and the Gothic style of Italy was a delicate veneer of lace-like forms, veiling the broad, simple walls of a Roman construction. It is manifest, then, that only the phantom of a Gothic art appears in Italy, always excepting the Gothic art of Venice, which is in truth an Oriental art, and that it is in the details that the Gothic style is plainly manifested. This detail is delicate and interesting. In most cases the masses of the buildings and towers are comparatively uninteresting.

STA. MARIA DELLA CROCE, CREMA.

The spire of the North becomes merely a steep, pointed roof in the South, and the four corner pinnacles are set on in such a fashion that it seems possible to remove them without affecting the integrity of the building, as they have little relation either in scale or in construction with the masses below. Of the Renaissance towers, little better can be said. In Venice Palladio and Sansovino erected plain, square, brick campanile, and terminated them with classic bell decks, surmounted by steep pyramidal or conical roofs. The design is simple and severe; the contrast of white marble between the red brick tower and the dark roof is excellent, and these towers are distinctive, distinguished, and the best of their class, in fact they are classic monuments elevated upon medieval shafts.

STA. MARIA IN STRADA, MONZA.

But when the pilaster treatment of the Renaissance style begins to make its appearance upon the successive stories of bell towers, the confusion of horizontal and perpendicular lines produces a very unsatisfactory result, and as the style begins to decay, inasmuch as novelty is sought for at the expense of good taste and proportions, the Renaissance towers become scarcely worthy of notice, occasionally amusing and interesting, and capable of being commended by that last of compliments, *i. e.*, that they would make good etchings, but scarcely be considered good architecture.

For it is very nearly axiomatic that any pronounced architectural form is at its best when treated with lines in the direction of its mass, and this is exactly what the Renaissance style with its superposed orders did not do when applied to towers. As a natural result, the worst of these towers are those which are elaborated the most, and the best are those like San Giorgio, in Venice, where architectural forms are confined to the termination of the towers, and to the natural efflorescence of the shaft. These papers have by no means exhausted the list of Italian towers. They are merely intended to draw attention to typical forms, and it will be seen that the simpler their forms, the more nearly constructional, the more effective the towers become.

S. GIORGIO MAGGIORE, VENICE.

They are an absolutely distinct class by themselves, in no way partaking of the rich development of buttress, gable, pinnacle, and

spire characteristic of Northern work, and should not be compared with that work; but in their own way — rising in simple, clear-cut grace above the long horizontal roofs of Italian cities — they possess

CATHEDRAL, SIENA.

a charm of sincerity and of quiet dignity that we should be loth to lose.

CREMA. S. Maria della Croce, built between 1490 and 1515, by Giovanni Battista Battaglia, of Lodi, shows a mixture of Gothic tradition and influence of Bramante in the church of S. Maria della Grazie, in Milan. The tower suffers from two distinctly superposed orders, the lower cornice being as important as the upper, but the octagonal termination is well proportioned.

LORETO. The church was built early in the fourteenth century,

CHURCH OF SANTA CASA, LORETO.

and has been again and again enlarged. The dome is by Sangallo and Bramante; the façade and probably the tower by Calcagni, 1587; the upper part, with its bulbous termination, is by Vanvitelli. The tower is somewhat octagonal in plan, the upper portion badly proportioned to the lower. It has unnecessary pediments as ornamental features, and a most peculiarly uncouth spire, excellent in its color proportion, but awkward in form.

MONZA. S. Maria in Strada. Gothic church, dating from middle of the fourteenth century, with a very delicate Gothic dwarf tower, with very miniature corner pinnacles, delicate terra-cotta and brickwork, and beautiful window on the bell deck.

STA. MARIA DELLA SALUTE, VENICE.

SIENA. Cathedral. The campanile, a simple, delicate, square tower of seven stages, was rebuilt in the fourteenth century by Agostino and Angelo da Siena. It is striated in white and black marble, and is a variation of the brick Lombard type with Gothic pinnacles. The spire is octagonal, of stone. It is a very beautiful tower.

TURIN. La Superga, built in 1717–1730, by Juvara. Upon each wing is a rococo tower with bulbous spire, but in this case the pinnacles are so arranged that they serve to carry the line of form from the lower mass up into the spire successfully. This tower is

LA SUPERGA, TURIN.

excellently proportioned above the roof, but seems to need greater and higher substructure. It is, however, one of the best rococo towers in existence.

VENICE. S. Giorgio Maggiore, by Palladio, in 1565, with a very graceful, beautiful square brick tower with stone belfry, circular stone lantern above, and conical spire.

S. Maria della Salute, by Longhena, 1632, has two delicate campanile, of which the arched pediments and domed terminations harmonize with the great dome of the church, but are not successful in themselves.

BRICK VAULTS BUILT WITHOUT CENTERS.

Translated from the "*Anales de la Construccion y de la Industria.*"

BY A. C. MUNOZ.

IN the province of Extremadura, Spain, timber is so scarce that in construction it becomes necessary to dispense with its use whenever possible, even in temporary supports such as centers for arches or vaults; as a result of this, almost all the brick vaults in that province have been built without the assistance of a center.

Several methods are in use, which differ but slightly from each other, and according to the kind of vault to be built. It may be said that all the different methods are based either upon the use of quick-setting mortar, or on taking advantage of the friction between the bricks and the mortar, to temporarily hold them in place until the mortar sets or until the vault is closed.

The vaults which depend on the quick setting of the mortar may be divided in two groups; in those of the first group the bricks are placed with one face tangent to the intrados curve, as in the Guastavino construction; in those of the second group, the bricks are placed with one side tangent to the intrados curve.

In the first group there are three methods of construction which are generally used for segmental barrel vaults, though semicircular ones, as well as groined and cloistered vaults, may be similarly constructed.

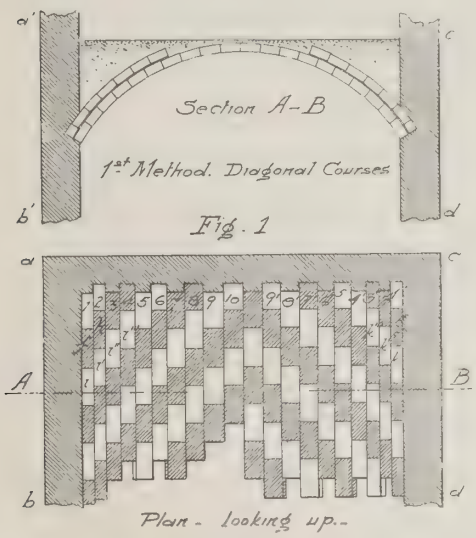


Fig. 1

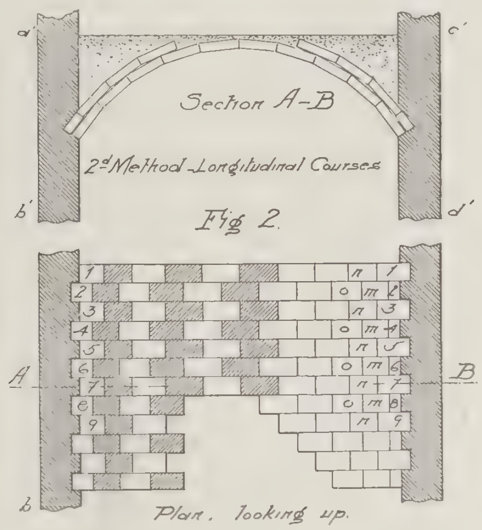


Fig 2.

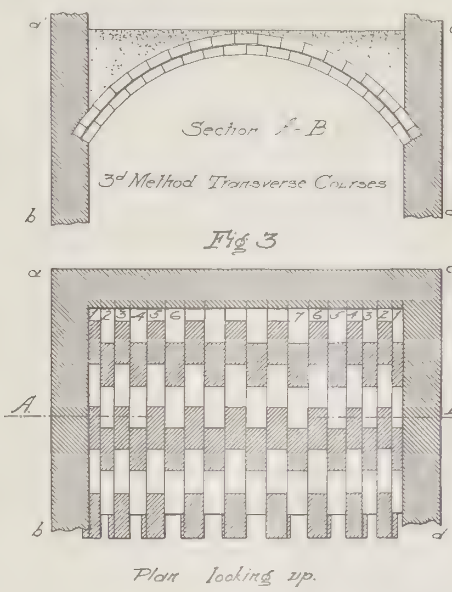


Fig 3

GROUP I. FIRST METHOD OF DIAGONAL COURSES.

In Fig. 1 let ab and cd be the side walls from which the vault springs, and a-c one of the head or end walls. A small groove determining the curvature of the vault is cut in the wall a-c and in the side walls ab-cd horizontal grooves are cut to receive the springers. It is preferable to form these latter grooves while the side walls are being built.

This done, the bricks and half bricks 1, 2, 3, 4, . . . 1′, 2′, 3′, 4′, are inserted in the groove on the wall a-c, in the above order, beginning at the two corners simultaneously and using quick-setting mortar. This first ring finished, the springers g and f and the brick h are laid; then, beginning always at the springing line, the diagonal courses i, i′, i″, i‴, and k, k′, k″ are built, resting each brick partly on the one previously laid and partly on two bricks of the previous diagonal course, the workman holding each brick until the mortar has set enough to support it.

Skillful workmen build these vaults by the eye, but for careful work it is better to guide the construction by means of strings stretched between the head walls, and determining the curvature of the intrados.

Should there be no head wall, the first ring 1, 2, 3, 4, . . . 1′, 2′, 3′, 4′, would have to be built over a center, but the diagonal courses would be built as in the previous case.

When the vaults are of great length they are usually divided into several sections by transverse arches and the sections vaulted separately but simultaneously, beginning at both sides of the transverse arches.

SECOND METHOD OF LONGITUDINAL COURSES. (FIG. 2.)

In this method, a groove having been cut or built in the side walls, the springing courses 1, 2, 3, 4, 5, on either side composed of bricks and half bricks is first constructed, and the following longitudinal courses are constructed by inserting the bricks m-m between every two projecting bricks of the springing course, and then by inserting the bricks n-n between the bricks m, and thus successively, working from both sides upwards until the vault is closed at the crown.

THIRD METHOD OF TRANSVERSE COURSES. (FIG. 3.)

In this method, as in the first, grooves are cut in the end wall and in the side walls. The first course consists of bricks and half bricks built into the grooves of the end wall a-c, and as in the second method, the following courses are constructed by inserting the bricks between every pair of projecting bricks of the previous course, thus forming a series of transverse courses.

These three varieties of vaults are useful when not intended to support a great weight, and are often used in building staircases. Their strength is increased by making them of two thicknesses of brick, in which case care should be taken that the joints of the upper arch do not correspond with those of the lower one. Also a good layer of mortar should be laid between the two arches.

The mortar used in the second arch need not be quick setting, as the lower one takes the place of a center.

When, as is most generally the case, chalk is used to make a quick-setting mortar, care must be taken not to close the vault until the mortar of the portion built has thoroughly set, for the reason that chalk increases considerably in volume while setting; and should the vault be closed at once, a thrust would be created at the springing of the arch which would either crack the supporting walls or the arch itself, and even destroy the latter.

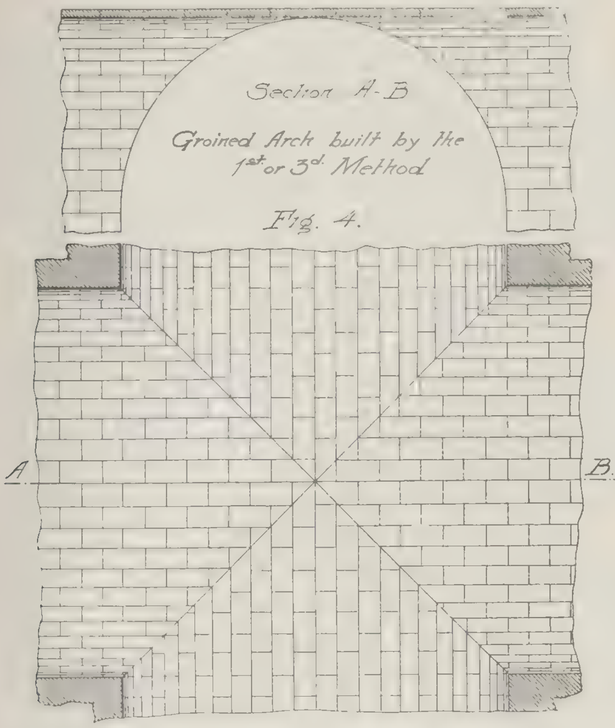
Cloistered and groined vaults are also built by the three methods described, the first and third methods being better adapted for groined vaults. At the groins or at any curves of intersection the bricks are cut to fit. In careful work it is better to determine accurately the curves of intersection and guide the construction by means of light wooden frames or strings.

Fig. 4 is a groined vault built by either the first or third method.

The method often used for ordinary brick vaults, in which the rows of brick are perpendicular to the groins, cannot be employed

when working without centers, as the joints would be helycoidal planes, and it would be impossible to give them by the eye their proper inclination at the different parts of the vault.

In all these vaults their stability depends on the thorough



adherence of the mortar and the bricks, which soon form a solid mass and reduce the thrust to a small quantity.

GROUP II. BRICK ARCHES AND VAULTS WITH "VERTICAL LEAVES."*

The difference between an ordinary arch and one of vertical leaves is that in the first the faces of the bricks are in planes radiating from the axis of the arch or vault, while in the second the bricks are laid with their faces in parallel planes perpendicular to the axis, thus forming a series of vertical leaves of the thickness of one brick.

The left half of Fig. 5 shows an ordinary arch, and the right half shows one of vertical leaves.

These vaults are built by cutting out on the end walls a channel or groove about ½ in. deep, and determining the curvature of the vault, the width of the channel being equal to the thickness of the vault, which may be half, one, one and a half, or two bricks. The first leaf is built by covering with quick-setting mortar one face of each brick, and the edges, forming the joints, and sticking them in place in the channel, beginning at the springing lines. The first leaf finished, the second and successive ones are constructed similarly, sticking the bricks against the previously built leaf and breaking joints.

When there is no end or head wall, an arch of three or four leaves is similarly constructed at each end with the aid of a light frame, after which the vault is built against these arches, as explained.

Vaults of this kind also depend, for their stability, on the thorough adherence of the mortar to the bricks, and on the quick setting of the mortar.

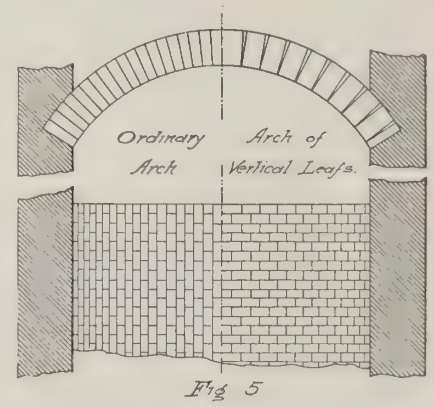
BARREL VAULTS WITH "INCLINED LEAVES." (FIG. 6).

These vaults are a modification of those just described, and in which the successive leaves are in parallel but inclined planes. In these, the use of quick-setting mortar is not required, as they depend on the friction between the bricks and the mortar for stability during construction.

* The word "leaf" is perhaps the best to use to express the idea of a series of thin arches made by the bricks, as in the construction to which the word applies; besides, it is the translation of the Spanish word "*hoja*" used in the original.

Vaults of this kind are generally composed of two distinct portions, the lower or springing portion, in Fig. 6, that between the lines ao-qo, forming the angle and the upper or crown portion that between the lines qo-q'o, forming the angle β.

The lower portion is constructed like an ordinary arch, but without using centers, the joints pq, at which this mode of construction stops, being determined by the angle of friction of the brick with the mortar, represented by α; for, while the inclination of the joints is smaller than this angle, there will exist frictional stability. Beyond this angle, however, frictional stability no longer exists, and to finish the vault centers would be required, unless the system of construction is changed.



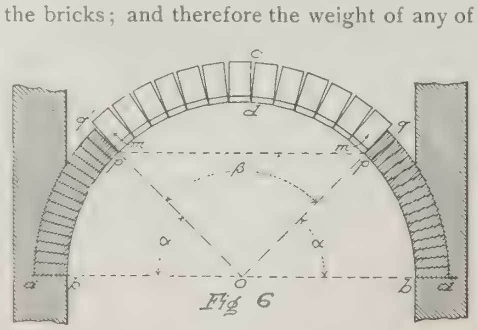
The required system for the upper portion of the vault consists in laying the bricks with their faces parallel to a plane having a given inclination (not greater than the angle of friction) and forming a series of inclined parallel leaves of the thickness of one brick.

One of these rings is shown in Fig. 7 in section and in side view by p′ d′ c′, in Fig. 8, in plan by p d p, and in Fig. 6, in front view, by p q c-q′ p d.

To construct the upper portion of the vault, an inclined channel, p q c-q′ p d, Fig. 6, is cut out of the head wall. The bricks m-m are laid with their faces at an angle not greater than the angle of friction, one end of the brick being tangent to the curve of the intrados. Then the bricks 1-1′, 2-2′ (Fig. 7) are similarly laid until the first complete leaf 3-3′ is formed.

The following leaves are similarly built, until the vault is closed at the opposite head wall, or, as is more often the case, the vault is closed at its center, the construction having proceeded from both head walls simultaneously. The closing leaves are constructed in different ways, as shown in Fig. 9, at A and B.

In this construction an outward thrust is produced against the head walls by the leaves which rest against them. This thrust is easily determined, considering how the forces act. The weight of the first or corner bricks m-m concentrated in its center of gravity resolves itself into two components, one parallel to the plane of the leaves, the other normal to it. The first is counteracted by the friction of the bricks with the mortar; the second or normal component presses against the head wall. Precisely the same occurs with all the bricks; and therefore the weight of any of the leaves forming the vault, resolved into its two components acting through the center of gravity of the leaf, will produce, first, a thrust parallel to the plane of the leaf and acting against the springing course m-m from where it is transmitted to the side walls, increasing the thrust due to the lower or springing portion of the vault; second, a thrust normal to the inclination of the leaves, which is transmitted to the next one, and so on for all the other leaves.



Thus, in Fig. 7, all the normal components to the left of the line m′-t′, which is perpendicular to the inclination of the leaves, will act on the springing course m-m′, while only those to the right of the line m′-t′ will act on the head wall.

Representing the weight of the portion m′ n′ t′ (Fig. 7) by W,

and the angle of the inclination of the leaves by α, the thrust $T = W \cos. \alpha$ will act through the center of gravity of the portion $m' n' t'$. The stability of the head walls is determined by taking moments about a convenient point, as h in Fig. 9, by which is obtained the equation $Tl = W^1 \times \frac{x}{2}$ in which T is the thrust of the portion of the vault to the right of the line m'-t' and acting through G, its center of gravity.

W' is the weight of the head wall.

x is the width of the head wall.

l is the distance of the point h from the line of action of T.

If there is no head wall against which the first oblique leaves may be built, an arch is constructed by the ordinary method, using a

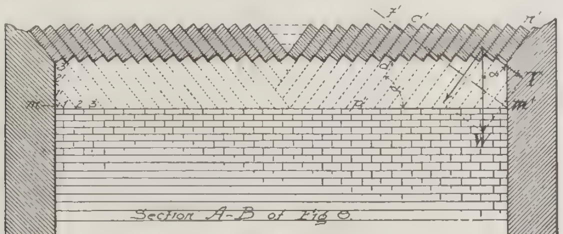


Fig 7

Plan of Fig 7 looking up.

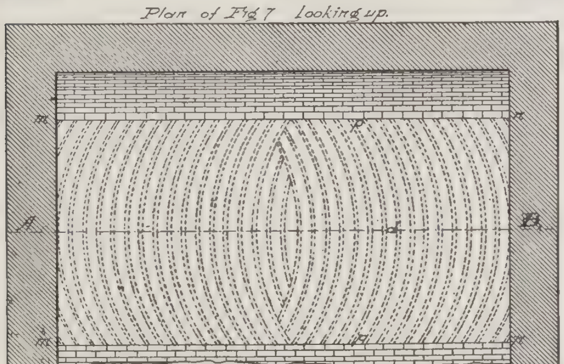
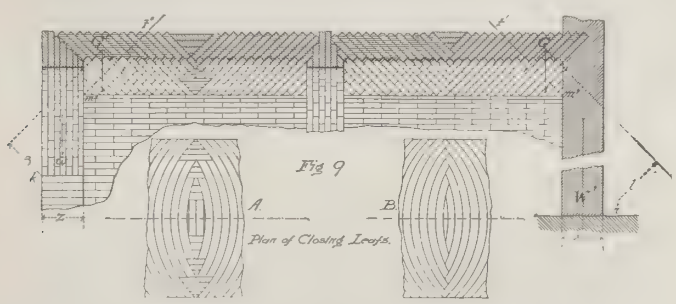


Fig. 8.

center, or by the method of "vertical leaves." The arch must be strong enough to resist the thrust, and its width is obtained from the equation $Ts = W_1 \frac{z}{2}$ (see Fig. 9), in which T is the thrust of the portion of the vault to the left of the line $m'' t''$; s is the distance of the



point k to the line of action of T; w' the weight of the head arch, acting through its center of gravity; and z is the width of the head arch.

(*Will be concluded in March number.*)

THE WEIGHT OF THE PARK ROW BUILDING.

NATHANIEL ROBERTS, M. Am. Soc. C. E., who is planning the steel construction for the new thirty-story office building on Park Row, New York City, of which R. H. Robertson is the architect, estimates the total weights of the building as follows:—

Weight of building	56,200 tons.
Weight of steel	9,000 „
Total	65,200 „

The foundations will be laid at a depth commensurate with the height of the structure, the first stone course being 34 ft. 4 ins. below the sidewalk, while piles extend 20 ft. deeper still.

Architectural Terra-Cotta.

BY THOMAS CUSACK.

(*Continued.*)

THE two Tuscan columns (Fig. 8) used on a window forming the central feature of the Sixth Avenue elevation of the Siegel-Cooper Building, New York City, being 1 ft. 10 ins. diameter, it was thought advisable to build them up in sections, a proposal to which the architects readily assented. The shaft is jointed horizontally into seven sections, and vertically into three segments, making a total of twenty-one pieces, in the setting of which the joints were broken every course. The base and capital are each in one piece; and though much larger than those used in the shaft, present no difficulty in making, because the slight variation in shrinkage (just enough to cause an eyesore at a flush joint) becomes inappreciable when the joint occurs at a projecting fillet. The general effect proved very acceptable, and amply justifies the means taken to obtain it. There are several other columns of a similar character used on this building, mostly on the tower, but the maximum diameter being 1 ft. 5 ins., some were made in five and others in six complete drums. They were handled in the manner described for Fig. 1, and when set in position appear to satisfy every requirement.

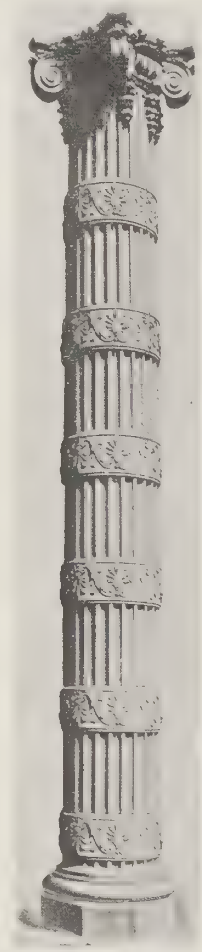


FIG. 11.

Thus far our remarks have applied exclusively to columns of the Doric, Ionic, Corinthian, and Tuscan orders. The examples cited may be considered merely as types of many hundreds that have been made with a fair degree of success, and of methods by which still greater success may be attained. They will, we hope, be sufficient to show that the difficulties by which the terra-cotta maker is beset, though onerous, are by no means insurmountable. The making of these columns requires mechanical skill of a high order, together with a special knowledge of clay, that comes best and surest to men who have had actual experience in handling, or opportunities of observing and studying its behavior under various conditions. Knowledge of this kind cannot be "read of in books, nor dreamt of in dreams." It must be acquired by very close and prolonged contact with the work, and some of it may be all the more effectual if absorbed, as Joey Ladle, the cellarman, was wont to receive his tipple, not by way of the throttle, but simply "taken in through the pores." Many and various are the expedients resorted to of a purely technical kind, in the several stages of manufacture, but all having the same object in view, viz: to counteract the ever-present tendency to warp, or sag, in the drying; and to promote uniform shrinkage in the blocks, as they pass through the final but inexorable ordeal of fire.

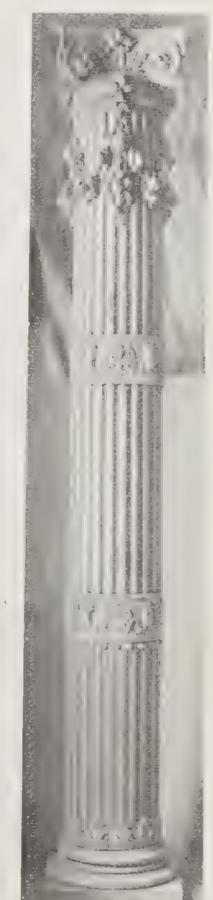


FIG. 14.

In columns of Saracenic, Byzantine, and late Romanesque char-

acter, few, if any, real obstacles will be encountered in their manufacture. The necessity for true alignment does not occur in them to the same extent; and the detail that may legitimately be introduced in the way of bands, spirals, zigzag flutings, lozenge, and diaper indentations of endless variety, serve to conceal such imperfections as may occur in the burning. The columns usually met with in Spanish Renaissance may likewise be included in this category. The Oriental richness of detail introduced, first by the Arabians, and then by the Moors, becoming assimilated with Italian outlines, produced a phase of Renaissance that is well within the limit of terra-cotta construction, and admirably fitted for plastic enrichment. The methods adopted in the case of previous examples will serve for them also, subject to such modifications as may fit in with particular circumstances.

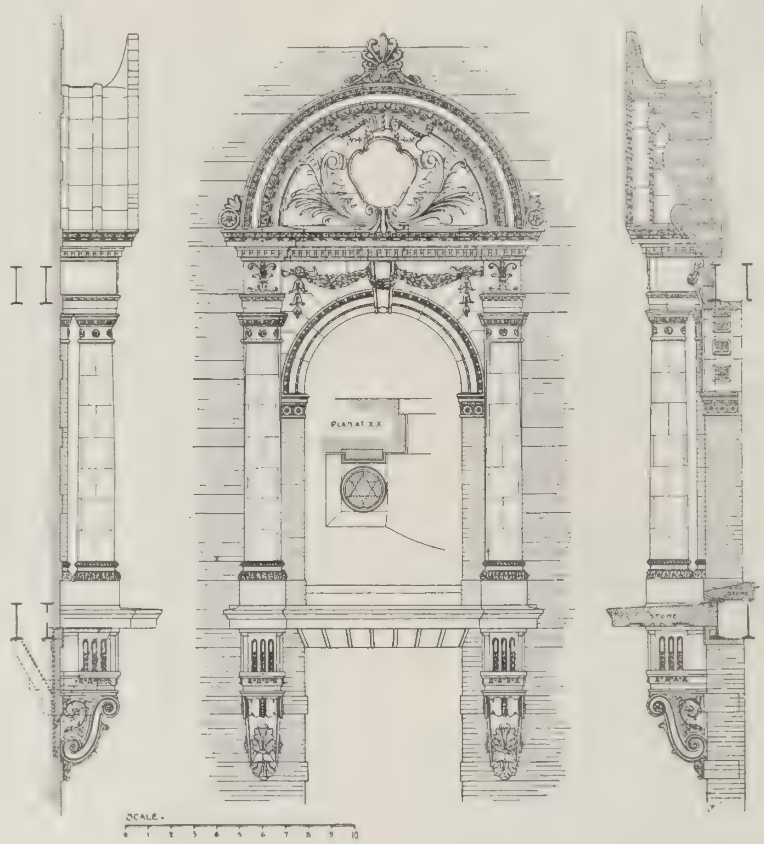


FIG. 8.

The parting of the ways between the French Renaissance of native growth and that previously introduced from Italy by Vignola and Serlio, found expression in the work of Delorme and other architects towards the close of the sixteenth century. The earlier portion of the Louvre, the Chateau d'Anet, and the Tuileries showed a divergence in many things, the most notable innovation among them, from the present point of view, being the rusticated pier and pilaster bands; and in admirable keeping with these followed columns (Figs. 9 and 10) into which were introduced bands of a more ornamental character, alternating with the fluted drums. These bands having but little projection, and adhering closely to the entasis of the column, did not in any way mar its outline. The idea of strength and vigor was thus obtained, without any sacrifice of grace, and when it was thought desirable to still further subdue the severity of the flutes, this was done by a husk, a ball-flower, or a diminishing drop ornament. These features could not have been introduced with any view to the use of terra-cotta, for the examples quoted were all executed in stone; but had such really been the intention, no device, however deliberate, could have more completely subserved the end in view. There is hardly anything within the wide range of its application to architectural purposes so ideal in point of fitness, and yet so well within the scope of economical execution. At any diameter up to two feet the drums and bands would be made in single blocks, being compact in form, and of convenient size for handling, with no troublesome projections to care for, nor salient angles to crack by premature or unequal drying. If much above that size they would be made in quadrants, the drums being jointed on the axis, while the bands would break joint on the intermediate angles, as in Fig. 11. A pair of these columns, designed by Messrs. Nolan, Nolan & Stern, of Rochester, were used by them on the Chamber of Commerce Building, recently erected in that city. In this case they are built around a steel core forming part of the structural support of a twelve-story building, of which we may have something to say when dealing with cornice construction. Columns of this character are, of course, susceptible to any suitable style, or degree of ornament, and may be varied in detail by modeling two alternating bands. These may again be multiplied by varying the central feature of the design on each of the four sides, and then by merely turning them on their axis in the setting, it would be possible to get eight different combinations when viewed from any one standpoint. Something of this kind is done in the columns of two very beautiful windows on the New Street front of the Manhattan Life Building, New York (Fig. 12). The chief thing to regret in that case is that they are situated on the sixth story, and are therefore doomed to blush unseen, wasting much of their sweetness on the preoccupied denizens of the Stock Exchange. The faces, however,

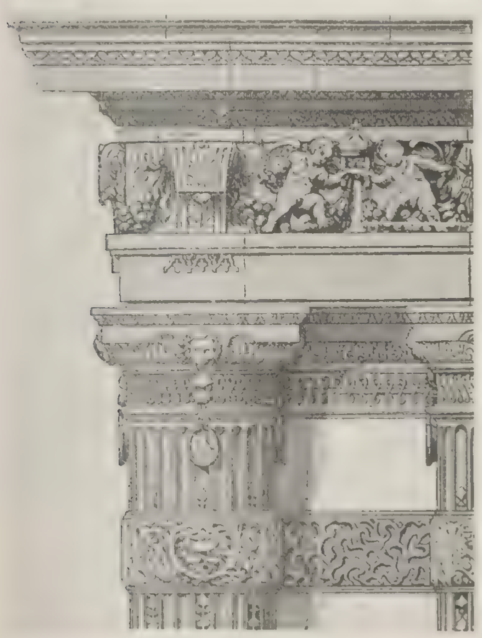


FIG. 9.

FIG. 12.

are clearly defined and artistically finished, and would stand critical inspection if used for interior work. This is a very modern building in construction and appointments, and in these respects represents modern ideas, but it will be seen that the architects did not allow the terra-cotta contractors to forget that: —

> "In the elder days of art,
> The builder wrought with wondrous care,
> In the unseen and hidden part,
> For the gods see everywhere."

The late Richard M. Hunt, just fresh from the Beaux Arts, gave to columns of this class a fitting introduction some forty years ago in one of his first works in New York City. They were made the chief distinguishing feature in the design of a residence on the north side of 38th Street, a little west of Fifth Avenue. At a later

FIG. 12.

date some "archieteck" undertook to imitate this house; which he did in a particularly tame and colorless caricature, built on the abutting lot to the west. The lapse of time has not, in this case, been favorable to the survival of the fittest, for while the work of the architect has been torn down and rebuilt (perhaps in disgust), that of the copyist remains, a forlorn relic of fading gentility.

The original banded column used on the Louvre (Fig. 9), has since been modified on the one hand and emphasized on the other, in conformity with varying needs, and in keeping with widely different environments; but it has stoutly maintained its place as a distinct type in competition with, and often by preference over, other styles. If this has been so in the case of stone, where most of the laborious work and all of the carving must necessarily be done by hand, as distinguished from machine labor, there are obviously great advantages in the substitution of a material that can be molded into shape and finished by the modeler while in a plastic state. It is seldom that less than one pair of columns are required, but even with this number, the preliminary expense of models and molds, added to that of all other labor and material, will be less than half the cost of stone. With a greater number the relative difference in cost becomes more than proportionately large, because the set of molds necessary for one will, if need be, produce from thirty to forty columns.

In Fig. 13 we have one of eight very elaborate and yet appropriately enriched columns, used on the handsome new City Hall, Elmira, now approaching completion. Four of them support a pediment on the Church Street elevation, and the other four carry a similar pediment on Lake Street. The background of the shaft at its greatest diameter is 2 ft. 6 ins., diminishing to 2 ft. 2 ins. at the neck, from which the bands have a uniform projection of 1 in. The ornament is of necessity in very low relief, but so crisp in definition that its main outlines are legible at some distance. The drums are in quadrants, breaking joint with each other, and with the bands, which are also jointed in four pieces, leaving in each case an opening in the center, to be built solid in brick and cement. The making of these columns was capable of being simplified to such an extent that out of 16 molds of a convenient size was got 32 presses from each, or a total of 512 pieces, duly entasized, and requiring little, if any, fitting when taken from the kiln. The large capitals are each made in eight pieces, with joints that are practically invisible, and the Renaissance feeling infused into the Corinthian order is in complete harmony with all the ornament on the building. We do not hesitate to challenge comparison between these capitals and any of the contemporaneous examples in stone, which have been spoken of as exhibiting the highest attainable excellence in nineteenth century stone carving.

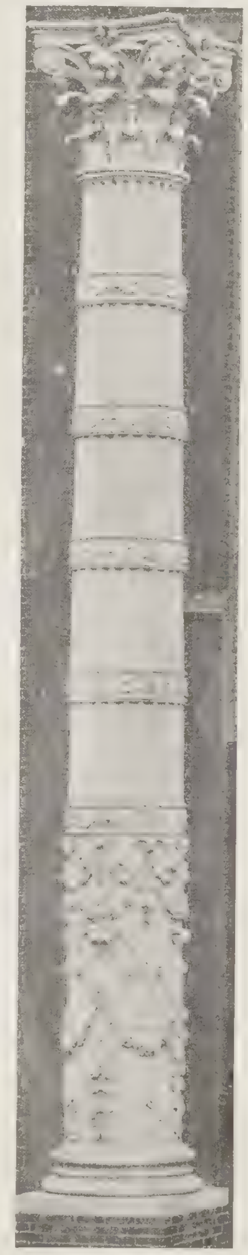


FIG. 13.

Two other columns (Fig. 13), smaller in size but of similar design, are used in the vestibule of the Church Street entrance, which is wholly in terra-cotta. This apartment, though not large, is exceedingly ornate. To each side of the columns stand paneled pedestals, carrying richly modeled pilasters and capitals, supporting an enriched architrave, festooned frieze, and cornice. Two niches have been thoughtfully provided in this vestibule by the City Fathers, in which, perhaps, to immortalize, at some later date, the more deserving of their number.

Columns of other sizes and designs might, of course, be added by way of illustration; but as they would be merely variations of those already given, their methods of construction would be determined by considerations such as have been stated. We have pointed out the chief difficulties that arise in the process of manufacture, and the extent to which, as well as the means whereby, these may be minimized, or wholly overcome. Where architects are willing to keep their demands within reasonable limits, and manufacturers ready to adopt such progressive methods as a riper experience may suggest, both can look forward to correspondingly successful results.

(To be continued.)

No good building was ever yet erected in which the architect designed the front, and left the flanks or internal courts to take care of themselves. So, also, no good building was ever seen in which the exterior only was thought of, and the internal decoration and design neglected. — *Street.*

Fire-proofing Department.

SOME VALUABLE OPINIONS ON FIRE-PROOF CONSTRUCTION.

CONTINUATION OF A SERIES OF INTERVIEWS WITH PROMINENT ARCHITECTS IN NEW YORK AND BOSTON, ON THE VALUE OF TERRA-COTTA AS A FIRE-PROOFING MATERIAL.

IN an interview upon the subject with Mr. John M. Carrère, of Carrère & Hastings, New York, he stated that in his practise he has never had occasion to use anything except terra-cotta for fire-proofing purposes. He considers the material the best in the market, but the mechanical details of construction and the methods of setting in place leave considerable to be desired, and as usually employed around a building it is difficult to get a thoroughly workmanlike job. Burnt clay is perfectly reliable and can be depended upon for ample protection to the structure, but it is often not used to the best advantage; and where, as is usually the case, the handling and setting of it has to be entrusted to absolutely unskilled labor, it is not strange that the results should leave a good deal to be desired. Fire-proofing has become so much of a science that it could with great advantage be left to experts, whose advice and cooperation would be welcomed by architects and contractors; and, indeed, if the manufacturers of terra-cotta are to retain their hold on the confidence of the public, Mr. Carrère believes it would be highly desirable that they should insist upon either setting their material in the building, or at any rate that the individual manufacturers should follow the terra-cotta after it is delivered at the building, and should personally satisfy themselves that it is used in the right manner, notifying the architect whenever it is improperly applied or put up in a bungling manner. In this way a great deal of the mechanical objection to terra-cotta blocks could be obviated. Mr. Carrère says this is precisely what has been done by manufacturers of other lines of building materials, such as the patent wall plasters, for instance, the manufacturers of which found it absolutely necessary to control the mixing of the plaster, and to supervise the application to the walls of the finished product in order that the material should not be misrepresented or misapplied, and the leading manufacturers of these goods make a business of reporting constantly to the architects any improper use of their material. Often when the specification for terra-cotta fire-proofing is well written and comprehensive an architect cannot be sure that the best use is made of it. A more scientific treatment of terra-cotta is needed.

Mr. Carrère advocated a more thorough fire-proofing of the columns in a building. The casings for such work should be heavier than is usually employed for this purpose, and should be interlocking, so that in case of partial damage by fire or water the blocks will not become loose. He thought possibly two casings would be better still, so the outer one, if peeled off by accident, would not expose the column. He thought also that the spaces about a column and also all chases left in walls for pipes, or about beam ends, should be thoroughly filled with terra-cotta, so as to leave no opportunity for flues in the wall through which fire might be led. In fact, his feeling was that while the system of fire-proofing with terra-cotta blocks is excellent, it is often not carried far enough, and terra-cotta is used too sparingly about a building to make it what could be called absolutely fire-proof. This is a pretty serious condition, as it leads to over-confidence on the part of the tenants, and when trouble comes, as it is very likely to in the long run, the whole system is apt to be condemned, whereas it is really the fault of the way in which it is used. He also spoke of a very common practise in regard to repairs around large buildings, which, though constructed with the utmost care by the architect and builder, are placed in the hands of an agent who may have little interest in architecture and less knowledge of the actual construction. The fire-proofing may then be cut out most recklessly, and where blocks or sections of floors are removed for changes or repairs the fire-proofing is not put back in a first-class manner, a bit of mortar or some so-called fire-proofing paper often being made to answer a purpose which could only be properly accomplished by a thorough replacement of the terra-cotta blocks.

Mr. Carrère was asked if he considered a stone facing a sufficient protection for columns which are built into exterior walls. In his judgment, the custom of building a steel frame and facing it with a relatively thin casing of stone on the outside is not only not fire-proof, but is really criminal in that it does not afford sufficient protection to the steel. There are numerous examples of just such species of construction in New York in which in some cases granite, which has all the appearance of solid blocks, is so cut away to receive columns that only 2 or 3 ins. separates the exterior surface of the wall from the metal, which is consequently protected by no external fire-proofing whatever. In case of fire this stone would be pretty sure to fly to pieces and the columns would be left bare. If circumstances render the use of stone imperative it is better that the column be made entirely free, set in from the wall and fire-proofed throughout with terra-cotta blocks, in addition to the stone facing. Mr. Carrère saw no reason why walls as well as floors and partitions should not be built of terra-cotta, and he instanced one prominent building in New York in which the system of steel construction is carried to its logical conclusion. The steel skeleton is constructed in the usual manner and is then filled in between the exterior portions with steel bars set at close intervals, the exterior facing of the building being of finished terra-cotta, while the backing and all the fire-proofing is of the ordinary terra-cotta blocks such as are used for partition work.

A vital issue that is often neglected is the arrangement of the rooms themselves in a building quite as much as the details of fire-proofing. We ought to build more on the compartment system, and the stairs, which are a vulnerable portion of the structure and are usually built of iron not enclosed nor fire-proofed at all, should be either cased throughout in terra-cotta, or, better, regularly constructed of terra-cotta or tile without the use of steel at all.

Mr. Carrère called attention to a construction which is often found in buildings in which the steel work forming the soffits of window and door openings is left without any protection whatever. A building cannot be called fire-proof while any stone or iron is so used that it can be affected by heat or water, and terra-cotta in some form should be used to protect the openings of the doors quite as much as the floors. He suggests an improvement in the forms of floor blocks, which are customarily made to lap under the flanges of the beams with a thickness of about 1 in. of terra-cotta. The blocks so formed are probably ample for any required protection to the iron, but the pieces which lip under the beam are so often poorly set or broken in the setting that he thinks it would be better to have at least 2 ins. instead of 1 for the flange under the beam.

Mr. Winslow, of Winslow & Wetherell, Boston, when interviewed, stated that he considered terra-cotta itself thoroughly fire-proof and that fire-proofing results are only a question of thickness of material and the manner of application. For that matter, good terra-cotta is nothing but brick, and brick is generally conceded to be the best and most thorough protection against fire, though the weight of brick precludes its suitable employment for thick floors. We may be able to trust other constructions, but we know we can trust terra-cotta, and in the present state of the science there is nothing so satisfactory. He cited the instance of the Pope Building, Boston, which was recently destroyed by fire. Had it been constructed of stone or any other material than terra-cotta and brick, there would have been nothing left of it, and though, owing to the fact that the floor construction was entirely of wood, the building was virtually destroyed, the brick and terra-cotta amply demonstrated their capacity to resist the action of heat.

Mr. Winslow said that in the so-called fire-proof building as actually built the real protection is usually not carried sufficiently far. In any office building, for instance, there is enough wood about the

floors and the finish, to say nothing of the contents, to make a very considerable fire if it once caught, and he would prefer to see a building in which all inflammable material of this sort was eliminated, so that, at the most, nothing but the contents could be consumed. In one of the large buildings recently constructed by his firm, a fire started in one of the rooms after it was all finished and ready for occupancy, the fire being caused by spontaneous combustion from painters' rags. The doors, windows, and portions of the floor were almost entirely consumed, but the fire simply burned itself out.

Winslow & Wetherell used hard terra-cotta in the construction of the large Tremont Building just completed. They have used elsewhere the porous terra-cotta, and are at present employing it in the Hotel Touraine, now in process of erection. They have found that the hard terra-cotta is quite brittle and is apt to break and crack in setting, and in practise they prefer the porous terra-cotta.

For partitions they have never felt inclined to use anything but terra cotta blocks, nor would they care to make any experiments with any other forms which have been offered to them. They consider that the terra-cotta blocks make a perfectly straight construction, and their experience leads them to believe that it will resist with perfect satisfaction the action of both fire and water. For furring on outside walls Mr. Winslow employs porous terra-cotta blocks. He has tried hollow brick, but on account of the brick being in itself not so strong as the ordinary hard-burned brick, he does not favor such employment and would prefer terra-cotta. Around columns, his practise has been always to fill in solidly with terra-cotta blocks, and where the column is hollow to fill the interior solid with cement concrete, applying a thickness of metal lathing and plastering outside of the whole. The fire-proofing of columns he considers a good deal of an open question, however, and feels that existing methods could be considerably improved upon in this direction. In regard to girders, he believes that if the webs are thoroughly encased and bedded with terra-cotta blocks, and the bottom flanges covered with metal lathing and plastering, no heat in a burning building, even though it might penetrate the plaster envelope, would be able to affect the steel, as the terra-cotta blocking beside it would take up the heat before it could act upon the metal.

As a matter of stability he considered terra-cotta floor blocks an excellent lateral brace. In the construction of the Hotel Touraine he began to have the floor blocks built in as the iron work was carried up, but has discontinued the setting of the blocks until all steel work is in place, as he believes the vibrations from the handling of derricks, etc., would tend to impair the set of the fire-proof work; but when the floor blocks are once in place nothing that will ever come in the building, in his judgment, will ever dislodge them or even unduly strain them. The most potent objection to the use of terra-cotta is the great weight which it necessitates per foot. For a low building this does not aggregate very much of a load upon the columns and foundations, but even admitting the question of weight, he would prefer to use terra-cotta blocks throughout on account of the added lateral strain. He cited the thirty-story building which is now under construction in New York, on Park Row, from plans of Mr. Robertson, representing, in some respects, the latest work in tall building construction, which, according to recent reports, is to be fire-proofed throughout with porous terra-cotta end construction floor blocks. Undoubtedly, all the various systems in the market were considered in connection with this building, but the fact that terra-cotta has been used instead of anything else is pretty good evidence that the material is satisfactory to those who have had most experience therewith. The setting in place of fire-proofing terra-cotta should not, however, be entrusted to careless or ignorant builders.

Mr. Winslow concluded that when you come right down to the broad work of fire-proofing a structure, he did not think anything was better than terra-cotta in its various forms. In England, the employment of terra-cotta has been constantly increasing of late years, which is ample evidence of how it is regarded in that part of the world.

Mortar and Concrete.

AMERICAN CEMENT.

BY URIAH CUMMINGS.

CHAPTER VII.

CEMENT TESTING.

(*Continuation of tests made by Prof. Cecil B. Smith.*)

SERIES V.

EVAPORATION AND CRUSHING TESTS AND EVAPORATION AND TENSILE TESTS.

(*a*) *Evaporation and crushing tests.*

This series had for its first intention, information on the comparative and actual amount of evaporation of moisture from different mortars made with different cements, but it soon developed into an endeavor to obtain some relation between crushing strength and evaporation. Any law on the matter, if there is any general law, will of course take years to demonstrate; but enough has been done to show that any investigations on this subject will be fruitful of results. The method of procedure was as follows: Mixtures were kept in damp air 30 days, then immersed 2 days in water of ordinary temperature, then taken out and weighed; they were then kept in the warm dry air of the laboratory at a temperature of about 65 degs. Fahr. exactly 2 days, when they were again weighed and immediately crushed. The experiments recorded in Table IX. were all made on 2 in. cubes, and 2 days was established, because it was found that at that time the evaporation was practically complete. Other experiments (not recorded) made on 3 in. cubes gave less evaporation per cent. and also less strength. Attached to this are three diagrams; the first two show strength and evaporation in different mixtures and with five brands of cement. The third diagram is the product of the other two, and is quite worthy of inspection, because it would appear from it that it would be possible to estimate fairly and accurately, without actually crushing a specimen, what load it would bear.

TABLE IX.

EVAPORATION AND CRUSHING TESTS.

NO. 11 — PORTLAND.

SERIES V.

Mixture.	Evap. per cent. in 2 days.	Crushing strength per square inch.	Product.	Max. wt. of 2 inch Cube.	$\left(\frac{2}{\sqrt[3]{wt.}}\right)$	Column 4 divided by column 6.
				oz.		
Neat.	1.48	3925	5809	10.43	22.16	262.1
1 to 1	3.41	2211	7539	10.12	21.71	347.3
2 to 1	6.20	1031	6492	9.39	20.66	314.2
3 to 1	10.39	544	5652	9.14	20.30	278.4
4 to 1	11.49	431	4952	8.92	19.97	247.9

NO. 10 — PORTLAND.

Mixture.	Evap. per cent. in 2 days.	Crushing strength per square inch.	Product.	wt.	$\left(\frac{2}{\sqrt[3]{wt.}}\right)$	Column 4 divided by column 6.
Neat.	0.97	4367	4231	9.84	21.31	199.0
1 to 1	2.20	3062	6736	10.23	21.87	308.0
2 to 1	5.59	1079	6032	9.43	20.72	291.1
3 to 1	8.61	*940	8093	9.15	20.31	398.4
4 to 1	11.68	504	5886	8.86	19.87	296.2

* One day older than others.

No. 3 — Portland.

Mixture.	Evap. per cent. in 2 days.	Crushing strength per square inch.	Product.	wt.		
Neat.	4.65	1863	8662	10.00	21.62	400.7
1 to 1	4.10	1875	7687	10.12	21.71	354.1
2 to 1	5.67	1417	8034	9.60	20.97	383.1
3 to 1	8.11	687	5572	8.95	20.01	276.2
4 to 1	12.56	412	5176	8.88	19.90	260.0

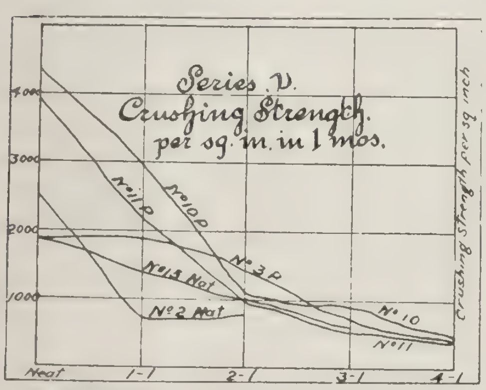
No. 15 — Natural.

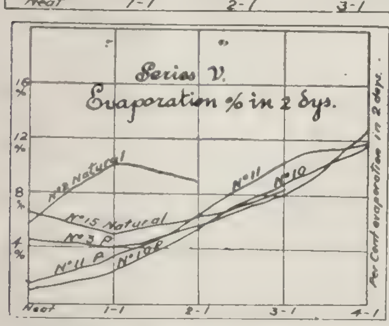
Mixture.	Evap. per cent. in 2 days.	Crushing strength per square inch.	Product.	wt.		
Neat.	6.76	1888	12762	9.40	20.67	617.4
1 to 1	5.08	1437	7300	9.65	21.02	347.3
2 to 1	6.12	988	6046	9.32	20.57	293.9
3 to 1	8.34	575	4796	9.05	20.16	237.9

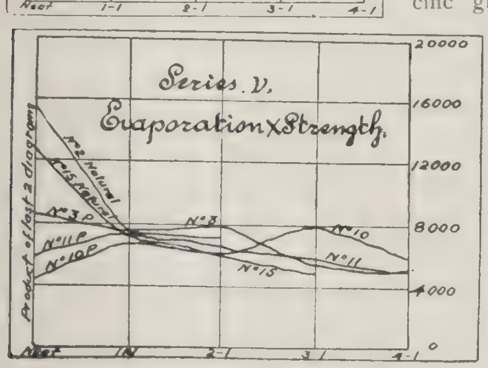
No. 2 — Natural.

Mixture.	Evap. per cent. in 2 days.	Crushing strength per. square inch.	Product.	wt.		
Neat.	5.93	2575	15720	9.43	2072	758.
1 to 1	10.32	703	7254	9.06	2016	359.9
2 to 1	8.93	810	7233	9.28	2057	352.6

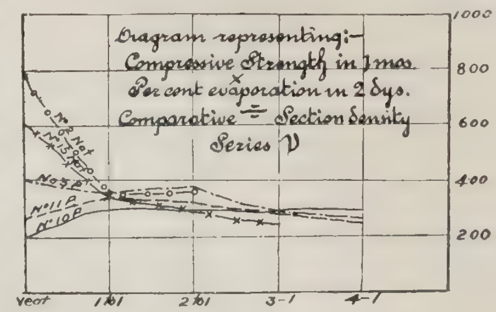
Reference to the table and diagrams will show that the evaporation increases and the strength diminishes with the increase of sand in the mixture. This is, of course, almost self-evident, but the striking difference in the amount of evaporation for different cements neat is unaccountable. This difference disappears as the admixture of sand increases, and we are led, therefore, to conclude that there is something inherent in the cement itself, which aids it more or less in holding particles of water in suspension. The natural cements show high evaporation neat, so also does the No. 3 Portland, which has a high specific gravity (see general tables), and the cubes of which weighed more than those of the No. 10, which evaporated least. We cannot account for it on the ground of Portland and natural, but one thing is evident, that that same quality which





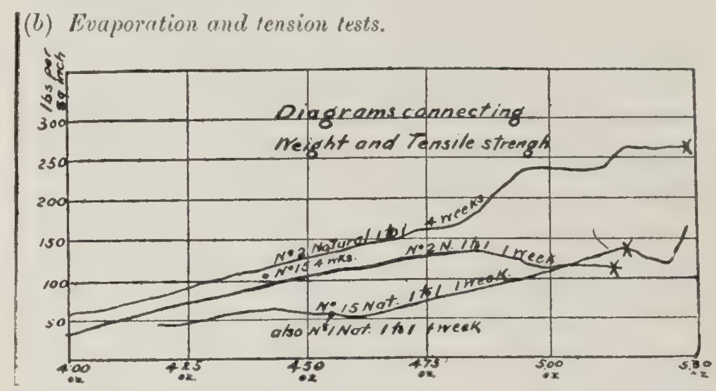


enables it to hold water in suspension also aids it in holding particles of sand together, but not particles of itself. The third diagram showing the convergence of lines on the 1 to 1 mixture is very striking. The *product* of the *crushing strength of a 1 to 1 mixture* and the *evaporation per cent.* under conditions named is practically CONSTANT. This is for one condition only, namely, 32 days, with access of water and 2 days' drying. This means in plain words that we may possibly be able to test with a balance instead of a crushing machine.

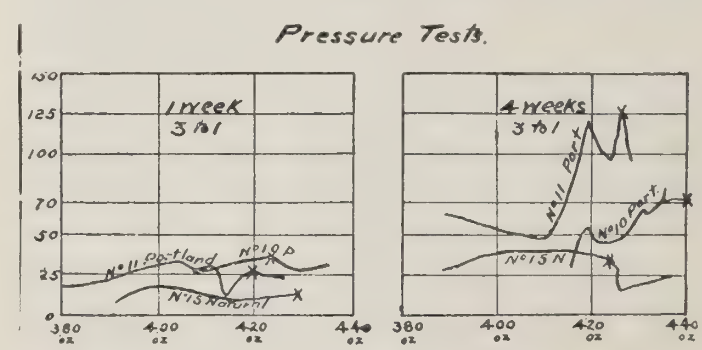


It is probable that the microscope would reveal a decided difference of structure in various cements. It is, of course, well known

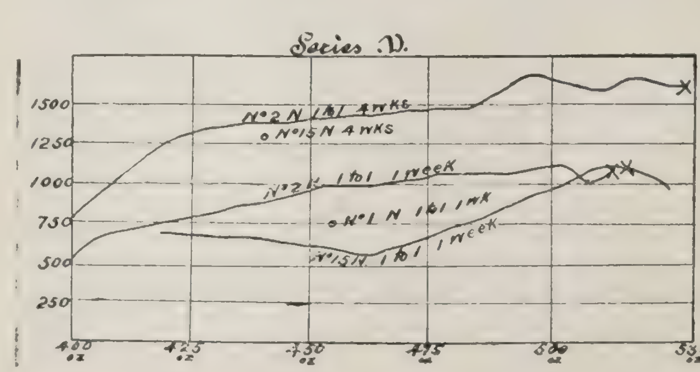
(b) Evaporation and tension tests.



that the underburnt natural cements have softer, rounder, and more easily pulverized grains than that produced by the highly burnt clinker of the Portland. It is possible, therefore, that the evapora-

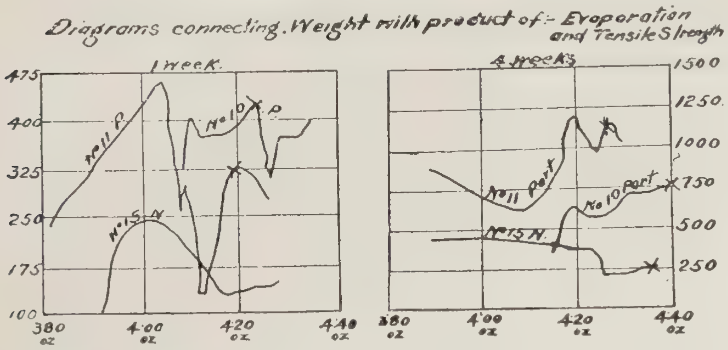


tion qualities of a neat cement would indicate more closely than anything else the degree of burning practised, independent of the fineness. It will be noticed by Table II., that the residues on sieves afford no clue to the density of the mixture, and no guide to determine beforehand the evaporation. Neither does the weight of the



specimens vary at all regularly either with the crushing strength or evaporation.

It would seem that the coarse, angular laboratory sand had its interstices just about filled up with a 1 to 1 mixture, and the strength of the mixture depended directly on the amount of evaporation, in an inverse ratio. The Evaporation diagram No. 4 is the same as No.

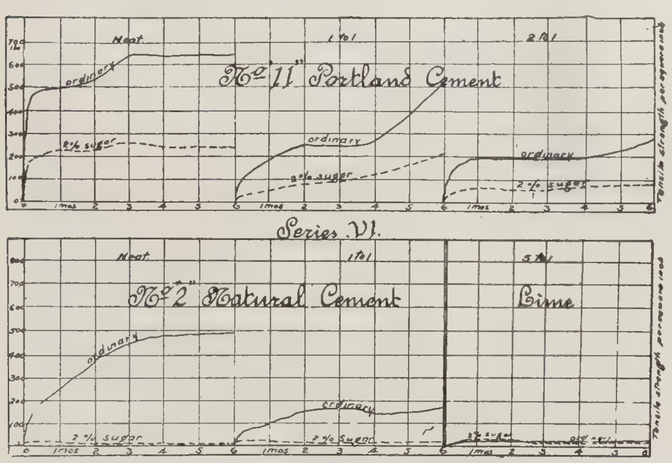


3, except that this product is referred to a uniform section density (*i. e.*) $\left(\sqrt[3]{weight}\right)^2$; the diagram is practically the same, showing that the variation in weight of test pieces made practically no difference in the results, *i. e.*, the per cent. of evaporation determines the strength in 1 to 1 mixtures, but is no criterion in neat ones.

In Table III. and Table IV. the per cent. of evaporation in 2 days is again given, and diagrams are plotted showing the relation between the tensile strength and the weight of the dried briquettes in the pressure tests, and also other diagrams showing the product of tensile strength and evaporation plotted on a base of weights of briquettes.

The × marks in the diagrams show the positions of tests made with 20 lbs. pressure and 20 per cent. of water, and they are seen to stand at prominent and usually maximum points on the diagrams, proving that this is the best point to select of all the tests made.

It will be seen in these diagrams as in those of crushing tests,



that in 1 to 1 mixtures the variation of evaporation and strength combined is not very great, but not so close as in the former tests.

The 3 to 1 tests are very erratic, as might have been expected with different per cents. of water and different amounts of pressure. It is evident that each cement has distinctive qualities of its own, because with the same weight of briquette the strengths vary, and this brings up the important point that in sand tests the strength ought to be referred to some basis of weight of briquette, because a slight variation in weight seems, from Table IV., to affect the strength very much. It would not take much evidence to determine the average weight, and all tests could be reduced to this by multiplying by $\left(\sqrt[3]{weight}\right)^2$ which would change the section density to a standard.

SERIES VI.

SUGAR TESTS.

Sucrate of lime is soluble in water, and it was chiefly a matter of interest to see the effect of sugar on cements in weakening them, because it has been asserted by several writers that the reverse is the case; one investigator several years ago showed by tests that from ½ to 1 per cent. of sugar would in 4 to 6 months give a gain in strength.

Sugar, in these tests, 2 per cent. of the amount of cement (by weight), was used, and the diagrams attached sufficiently indicate the results. In the Portland cement the strength ranges closely at 50 per cent. of the ordinary strength as far as 6 months, while with the natural cements, the sugar effect was overpowering. After 1 week's immersion the briquettes showed signs of cracking, and as time went on became completely checked, and expanded so much as to give practically no tests. This is further evidenced (see exhibit of briquettes) by the upper surface, which was protected by a coating of iron deposited from Montreal water, being intact, while the checking was greatest on the bottom where the water had free access.

The lime mixtures, kept in open air, showed encouraging results for 2 months, and seemed to prove that the use of sugar, in lime, as practised in India, was beneficial; but the 3, 4, and 6 months' tests disprove it. Altogether, it seems evident that this much or more sugar would be damaging in its effects on any kind of mortar in any situation, and it is extremely doubtful whether any sugar whatever would have other than a weakening effect.

In concluding this paper, the author cannot but help feeling that he is, as it were, dipping just on the surface of a vast subject, and that the more one finds out, the larger the unknown fields beyond appear.

In any efforts that have been made, the frequent manual aid and more frequent sound practical advice of Mr. J. G. Kerry have been of much service, and here is the place to acknowledge it.

The endeavor has been to find out anything of practical use to the engineering profession; and if any points raised here will fulfil this desire, the object of this paper will be, in the main, accomplished.

(To be continued.)

HEAT-RESISTING PROPERTIES OF PORTLAND CEMENT.

IN the "Digest of Physical Tests and Laboratory Appliances," Mr. J. S. Dobie gives particulars of the results of a recent investigation of the action of heat on Portland cement. Three different brands were examined, all of excellent quality, but two were of the slow-setting class, whilst the remaining one set very rapidly. Over two hundred briquettes were prepared, some consisting of neat cement, whilst in other cases one part of cement was mixed with one, two, or three parts of sand. The age of the briquettes ranged from two months to four years. In making the tests they were heated in a gas furnace to a temperature of from 650 degs. to 1,775 degs. Fahr. After removal from the furnace, every briquette was found to have lost weight, whilst in the case of the neat specimens, cracks were usually to be observed. These latter were less apparent in the case of the other briquettes containing sand. After cooling, the briquettes were tested for tensile strength with a load applied at the rate of 400 lbs. per minute. In all cases a marked decrease in the tensile strength was noted, which was apparently closely connected with the loss in weight of the sample. In those cases in which the reduction in weight showed that practically the whole of the water of crystallization had been driven off, the specimens had practically no breaking strength. The effect of different temperatures was, however, peculiar, since briquettes heated rapidly to 1,775 degs. Fahr. showed a loss of strength out of proportion to their loss in weight. When, however, the heating was slowly effected, these two losses were closely proportional. After cooling, the briquettes of neat cement could be crumbled to pieces in the fingers, whilst those containing sand disintegrated spontaneously on standing. — *British Clayworker.*

The Masons' Department.

THE ARCHITECT AND CONTRACTOR — IN GENERAL.

BY THOMAS A. FOX.

(*Continued.*)

MOST of the rules governing the honorable practise of the profession of architecture are the result of custom and usage. They are, therefore, much the same as should regulate all similar vocations, and are, consequently, so well known and understood as to need no particular attention or explanation. There is one condition of practise, however, affecting owner, architect, and contractor, which is almost always made mandatory, that is to say compulsatory, on the part of the architect, namely, that no architect shall accept "commissions." The constitution of the American Institute of Architects provides, and most of the other architectural organizations have a similar requirement, that "no fellow shall accept direct or indirect compensation for services rendered, other than the fees received from his client." Although there is no reason to suppose that this condition is often violated by those who belong to and practise under the regulations imposed by the various societies of architects, yet it must be admitted that an architect is often tempted by direct or indirect offers of commission, and it is fair to assume that such proposals would not be made unless they were sometimes accepted. In many instances violations of this rule have been known to exist, but it has been found impossible to prove the charge for the same reasons that it is always hard to prove bribery of other kinds, for such a transaction cannot be dignified by a term any less severe than this. Offers of commissions probably come of late more often from material men than from any other source, which is probably accounted for by the fact that competition has become so sharp that it is found hard to get even goods of merit on the market without resorting to some such measure, and also because commissions are now so generally offered and almost as often accepted with thanks in so many business transactions, that it is taken for granted that the architect will look with favor upon similar opportunities. The following circular, which has been lately framed by the Boston Society of Architects, to send to any one offering commissions, explains the case concisely and clearly, and it may be accepted also as defining the position of all architects who live up to the best principles of professional practise : —

"The enclosed communication has been received from you by a member of this society, offering a commission or special favors for the introduction and use of your specialties. Assuming, as is doubtless the case, that this is due to imperfect knowledge, on your part, of professional practise, allow me to point out that it is impossible for any reputable architect to receive commissions from material men for the following reason : The relation of the architect to his client is fiduciary, and the receiving of commissions which in the case of a business man might be perfectly legitimate is, in the case of the architect, in the nature of a bribe, as it leads him to favor certain materials for other reasons than his client's interests. On this account a by-law of this society provides that 'no practising member shall accept direct or indirect compensation for services rendered in the practise of his profession other than the fees received from his client.' In the hope that this information may lead to a change in your method of solicitation, which in the form referred to can only injure your interests with the class of architects whose approval you doubtless value, I am

"Respectfully yours, ——— ———

"Secretary Boston Society of Architects."

It can be seen from this circular letter that not only will the person offering a commission to an architect of standing fail to accomplish his purpose, but such action is liable to create a prejudice against both the individual and his material which will seriously affect the chances of their being favorably considered if at all. In this zeal to appear incorruptible many architects are inclined to treat offers of a commission much too harshly. In the case of a first offence on the part of a person who is presumably honest, it is only fair to assume that the offer was made under a misunderstanding of the conditions which should exist between the architect and those employed by him or under his direction. And in such instances, instead of making the person who offers a commission the object of his wrath, it would be much more profitable for the architect to first explain matters, and then find out what led the offender to think such a proposition was in order or would be entertained or accepted by an architect. An ingenuous way in which architects have been known to treat the matter of a commission, when they have learned that a sum for this purpose has been included in a bill for work or materials, has been to require the contractor to send a check for this amount to the owner, to whom, of course, the money rightfully belongs, for, as no one does work without profit, it is the owner who in the end pays all the bills, if they are paid at all. It is unnecessary to write at length on the subject of commissions; the facts in the case are clearly set forth in the two quotations given above, and the conclusions are self-evident. If a contractor or material man wishes the confidence and respect of the best members of the profession, he must depend entirely on the merit of his work or material. When he finds that offers of commissions or special favors are accepted, he may know that those who entertain such propositions, whatever may have been their professional standing in the past, are no longer to be considered as engaged in honorable practise, and he may rest assured that if any violation of the by-laws quoted above is brought to the attention of the officials of any society requiring its members to practise in conformity with such a rule, the offender will, if the evidence is satisfactory, be promptly brought to justice.

HOW TO PREPARE MORTAR.

MR. EDWARD WOLFF, an American authority on the subject of limes and mortars, makes some very interesting suggestions relative to the proper method of slacking lime and preserving it in good condition thereafter. He says : —

"The slaking operation should be done in a water-tight box made of boards, and so much water should be mixed in that the contents will never get dry, and a sheet of water will remain on top to prevent access of air. If the box will not hold the entire quantity of lime required, the contents may be emptied into a cavity made in the ground close to the pan, and this process may be repeated. This should be done at least two weeks before sand is added, or before the mortar is prepared for use. Slaked lime prepared and kept as stated has been found free of carbonic acid after many years, air and gas not having been able to find access.

RELATION OF COLOR TO QUALITY OF CEMENT.

MUNICIPAL ENGINEERING replies to the question, Has the color of cement anything to do with its quality? as follows : —

"As a rule, no. If a cement is very light colored, it is well to test it for strength, also for lime or possible adulteration with clay.

"If the cement is very dark, lampblack may have been added to deceive. Test for lampblack by dissolving in water, when, if present, an oily black film appears on the water. Lampblack of itself does no harm, more than to deceive ignorant buyers who think 'good dark color means good strong cement.' Color, smell, and feeling have very little to do with the value of a cement. Tests made with briquettes in tension are sure indicators of its value.

"It is surprising how many contractors and even cities trust entirely to the 'brand,' the manufacturers, or even the contractor, for a good cement. Cement tests are quickly and cheaply made, and should never be omitted in public or private important work."

Recent Brick and Terra-Cotta Work in American Cities, and Manufacturers' Department.

PHILADELPHIA.— Architecturally, at present, all eyes are turned to the exhibition of the T Square Club, held in connection with the sixty-sixth annual exhibition of painting and sculpture of the Pennsylvania Academy of the Fine Arts; this exhibition so totally exceeds anything of its kind ever held in Philadelphia that it has excited unusual comment, indeed we would have scarcely believed that the general public were sufficiently interested in architecture to give serious cognizance to an architectural exhibition. Such exhibitions are generally considered as dry, mechanical, and artistic blendings of ideas which the layman cannot comprehend without a great deal of effort, and they are consequently very little patronized; this has, however, been an entirely different affair, for — whether by the foresight of the committee or by accident, we know not — there have been shown in conspicuous positions many beautifully executed drawings in which the public at the present time are directly interested, and around these have been grouped many others, less interesting to the public by reason of their being from other cities, but withal, beautiful, interesting, and comprehensive. It is, without doubt, the finest collection which has ever been exhibited in this city, and the general study and attention which has been given it will undoubtedly advance the cause of artistic design very considerably. As this is the very matter which the members of the T Square

Club have for years been endeavoring to accomplish, it can be truthfully said in this instance that they have made decided progress this year, and gone a long step forward. It is to be hoped that they will carefully follow up the advantage thus gained, and by many more such events bring the architect, builder, and layman in closer touch than heretofore.

Of new work in prospect much might be said, as once again there are rumors of large undertakings; nothing, however, has taken definite shape except the work upon the new M which was begun a short time ago. The excavations are being pushed to the utmost, and it has been announced that the foundations and superstructure will follow immediately.

As if to decide quickly the question as to whether there shall

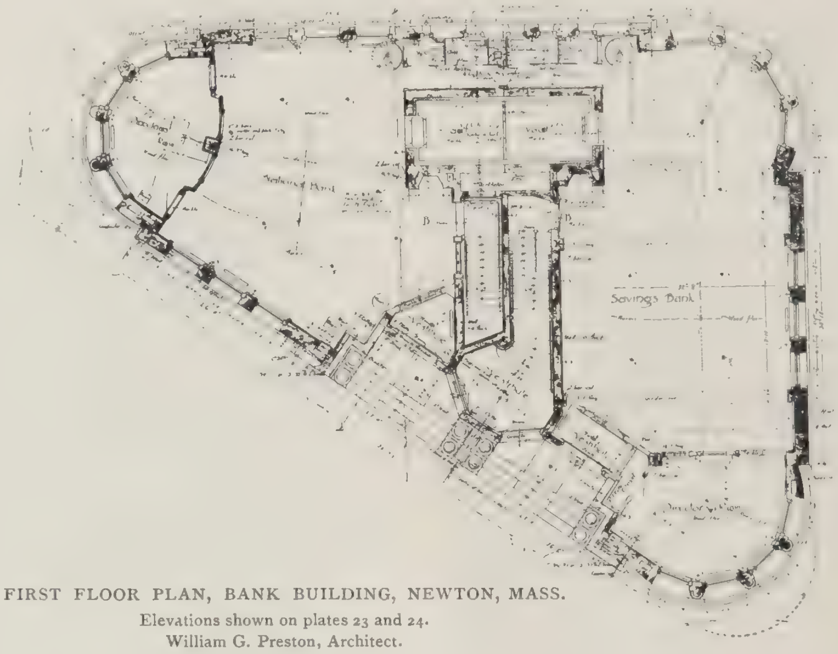
BUILDING FOR Y. M. C. A., 8TH AVENUE, NEW YORK.
Parish & Schraeder, Architects.
Built of gray brick and terra-cotta made by the Excelsior Terra-Cotta Company.

or not be a plaza in front of the city hall, came the disastrous fire of a few weeks ago, which practically destroyed every building in the block fronting the city hall on the northeast. This is one of the very blocks which the advocates of the plaza project have been endeavoring to have the councils condemn for that purpose, and the destruction of the buildings will now compel them to decide once for all whether it shall be done. It is obvious that there will never be another such an opportunity offered, and should councils fail to act now, the plaza project will undoubtedly be a thing of the past, and be shelved with the boulevard and other like propositions. There seems, however, to be a decidedly outspoken sentiment in favor of the project at the present time, and an ordinance has been drafted and published, for submittal to councils at their next session, which, if passed will at once clothe the proper authorities with power to take the preliminary steps in the condemnation proceedings, and it is not unlikely that the long-wished-for time has arrived when the city hall will be at least partially relieved from the danger of being entirely pent up upon all sides with sky-scraping buildings. If condemnation proceedings do not issue at once, active preparations will be made to immediately rebuild the destroyed portions.

Bids have been asked for the erection of a building on the corner of 7th and Sansom Streets, for the Philadelphia *Press;* the building will be 38 by 91 ft. in size, ten stories high, steel frame with brick walls, and stone and terra-cotta trimmings, fire-proof floors, etc. The drawings are by Theophilus P. Chandler, and the work of construction is to commence at once. It is said that as soon as this building is completed the Chestnut Street front of the lot will be cleared and rebuilt to conform with the work now being commenced.

Messrs. Cope & Stewardson have completed the preliminary drawings for the Pennsylvania Institution for Instruction of the Blind, which will be built this summer at Overbrook, one of the most beautiful of the newly laid out suburbs of this city; the building will be very large and commodious, will be built somewhat after the manner of the monastery, and will consist of a central administration building with reception and executive departments, and two wings, cloisters for girls and boys respectfully. The material for the building will be stone, plastered and pebble-dashed on the exterior, with trimmings and columns of terra-cotta, set in position by the stone-mason. Bids for the work will shortly be asked.

A very pretty alteration by Keen & Mead, architects, shown in the accompanying illustration, is situated on the corner of 15th and Jefferson Streets, is of Pompeian brick with red stone trimmings, the tympanum of the arches being of colored plaster, with small colored shields.



FIRST FLOOR PLAN, BANK BUILDING, NEWTON, MASS.
Elevations shown on plates 23 and 24.
William G. Preston, Architect.

ST. LOUIS. — At the present time there seems to be considerable energy back of the proposition to cut Locust Street through the Exposition Building from 13th to 14th Street. Should this be done, the scheme to give us a place in which to hold large meetings will necessarily be abandoned for the present, at least, as the proposed amphitheater was to be located in the north wing of the Exposition Building.

The property upon which the Exposition stands was given to the city years ago to be used perpetually as a public park, and was leased to the Exposition for fifty years, and the question as to whether a street can be cut through the property will doubtless have to be passed upon by the courts.

Churches have been among the many improvements that the growth of our city and the migration of the wealthy have made necessary. Last month three large churches were dedicated within eight days: The Lafayette Methodist Episcopal Church, the Lindell Avenue Methodist Episcopal Church, and the Jewish Synagogue for Shaare Emeth congregation.

The old Lafayette Church was a victim of the cyclone last May, and in the rebuilding the seating capacity has been more than doubled to meet the demands, and provisions have been made for addition in the future.

Messrs. Link & Rosenheim were the architects of the Lindell Avenue Church and the Synagogue, and in the latter they have designed a building to meet the modern requirements and advanced thought of the Jewish Church. Past traditions and customs have influenced them but little, and there is nothing to distinguish it from its near Protestant neighbors.

Besides the above mentioned there are a number of other large churches under contemplation, some of which will doubtless assume definite shape soon.

AUBURNDALE PUBLIC SCHOOL BUILDING. TOLEDO OHIO. — E. O. FALLIS ARCHT NASBY TOWER, TOLEDO. OHIO

CHICAGO. — It is too early for spring building and there will probably not be much of a rush this year. Business is indeed dull. Some architects who have been important factors in Chicago work say that they have done nothing for a year or more.

The items of most importance just now seem to be warehouses, of which about half a dozen are in progress. Mr. Dankmar Adler has two to build, one 80 by 100 ft., nine stories high, and the other 50 by 100 ft., eleven stories. Pile foundations will be used, and the general construction will be, at least partially, fire-proof.

One announcement is that Greifenhagen & Kingsley are designing an apartment building exceeding $100,000 in cost.

Dwen & White are directing work on the McCoy Hotel, which is to be remodeled at considerable expense.

J. H. Wagner is the architect of a $60,000 shoe factory, which is just beginning construction.

PITTSBURG.—As the winter months are coming to a close business in the architectural and building lines is livening up considerably, and much work is talked of and planned for the coming season. The Central Board of Education has settled on two sites for the proposed sub-high schools one in the East End and the other on the South Side.

NINTH PRECINCT POLICE STATION, BROOKLYN, N. Y.
Frank Freeman, Architect.
Architectural terra-cotta made by the New Jersey Terra-Cotta Company.

An ordinance has been prepared for an appropriation for the erection of an isolation hospital in this city, to accommodate one hundred patients, and to cost between $150,000 and $200,000.

Architect F. J. Osterling will prepare plans for an insane asylum, an addition to the Allegheny City Home at Claremont, to cost $60,000.

It is rumored that the Pennsylvania Railroad Company is contemplating the erection of a new station at East End, to be of brick, and cost about $75,000.

Architects J. E. Carlisle & Co. were the successful competitors out of ten of the leading architects of this city for the new school building at Turtle Creek. It will have sixteen rooms, be fire-proof, and cost $40,000.

The First Presbyterian congregation of Wilkinsburg is contemplating the erection of a church building, to cost about $30,000.

Architect F. C. Sauer is preparing plans for a new parochial school building for the St. Joseph's Church at Allegheny.

It is reported that Mrs. Mary Kaufman will erect about thirty houses along Fifth Avenue, Walnut, and Howe Streets. They will cost from $7,000 to $12,000 each.

Architect T. D. Evans is preparing plans for a residence for Geo. Bennett, Esq., to be erected on Fifth Avenue, Bellefield, to cost $30,000.

Architect Thomas Boyd has prepared plans for a Pompeian brick residence at Beaver, Penn.

Architect Edward Stotz has prepared plans for a new town hall at Sistersville, W. Va. Mr. Stotz was the successful architect in the competition for the People's National Bank to be erected at McDonald, Penn.

Homestead is agitating the question of erecting a new town hall.

Bradford is contemplating the erection of a public building, to cost $60,000.

There will be considerable building at Turtle Creek the coming spring and summer.

Westmoreland County will invite architects to submit plans for a new court house.

MINNEAPOLIS. — We are in the midst of our midwinter dulness, with more or less of uncertainty staring us in the face as to what the spring will bring forth. We have reason to believe that it will be a material improvement over last spring, both in the amount and character of the work to be done.

It is understood that our Chamber of Commerce will not erect a new building, but will cover their present lot with an addition, to cost approximately $50,000. Architects were hoping that a well-conducted local competition would spring from the erection of a new building. The present one is such an eyesore and so inconvenient that a new and more representative structure is devoutly wished for by those interested in our city artistically.

Architect George E. Bertrand has begun an education of the public on good architecture, and has presented some very tasty designs for the various problems arising in general practise, showing the adaptability of Greek models to our present needs. Let us hope his labor may not be in vain.

Two of our leading architects have turned their attention to the manufacture of acetylene gas, each having devised a generator that is superior to the others, and formed stock companies, and disposed of territory, etc. They will certainly find it more profitable than architecture, as it is practised in these parts. An architect, to be thoroughly conscientious and dignified, must either be independent or be content with a bare existence.

A medical building to be operated in connection with Hamline University by Minneapolis College of Physicians and Surgeons; cream brick and cut stone trimmings, and to cost about $50,000.

Governor Clough has recommended a prison for women, to be located near the twin cities, and to cost approximately $100,000.

Among the larger enterprises of the month may be mentioned school buildings at Waterloo, Ia., and Kaukauna, Wis., by Orff & Joralemon. The former 68 by 108 ft., 8 rooms, of Gladbrook brick, cost, $30,000. Latter, 80 by 100 ft., 12 rooms, of brick with slate roof, cost, $50,000.

MONMOUTH COLLEGE AUDITORIUM BUILDING, MONMOUTH, ILL.
D. E. Waid, Architect.

Flat building on Dayton Avenue, St. Paul, planned by F. A. Clarke, 18 apartments, to cost $75,000.

A bill has been introduced into State legislature calling for an inebriate department at Rochester Insane Hospital, to cost $50,000.

There is an effort being made to so shape legislation as to allow of completing our new Capitol Building within a reasonable time, and permit of a saving of from $20,000 to $50,000 dollars. There seems to be a disposition to use the full ten years contemplated by the bill, but those conversant with the matter hope that it may be put through in a more business-like manner and within a reasonable time, say by the time our next session of legislature sits, two years hence.

THE International Correspondence Schools of Scranton, Penn., have been in existence less than six years, but have amply demonstrated their reason for being by drawing pupils not only from Pennsylvania, but also from all over this country and from several foreign lands. We have received the Circular of Information of the Correspondence School of Architecture, which covers only one of the many branches in which instruction is offered. The method of these schools is implied by their name, and while they are not as far reaching as our higher technical schools and colleges, they are certainly a boon to the busy man; to the poor artisan who seeks to better himself; to the engineer in charge of a power plant, who feels the lack of education; and to the aspiring office boy in a busy architect's office, who wants to rise but cannot afford a college education. They offer a substitute, but a most excellent one, and to judge by the sample pages of instruction papers, the fifty dollars invested in one of the scholarships, if followed by a couple of hours of daily application, would certainly result in vastly enlarging one's powers, even if it did leave a few architectural facts and experiences still to be acquired.

BOHEMIAN CLUB HOUSE, EAST 71ST STREET, NEW YORK CITY.
Julius Franke, Architect.
Built of gray brick and terra-cotta made by the Excelsior Terra-Cotta Company.

NEW CATALOGUES.

THE STANDARD DRY KILN COMPANY, Indianapolis, Ind., present their case in one of the handsomest and best gotten up catalogues that has ever come to our notice. The covers are bound in leather, padded in album style; in fact, it is nothing less than an album, containing as it does some forty or more fine half-tone illustrations of large clay-working plants in this country. These illustrations are accompanied by testimonial letters from manufacturers, which must be accepted as conclusive evidence of the worth of the dryers and various other clay-manufacturing appliances which are made by this company. We presume this catalogue will be sent to any one upon application to the company, and certainly it should be possessed by every one interested in the manipulation of clays.

THE CUTLER MANUFACTURING COMPANY, Rochester, N. Y., have issued another interesting number of their series, entitled, "Details from Italian Palaces," measured and drawn by Claude F. Bragdon. The enterprise shown by this company in giving a series of sketches of subjects that have not been "published to death" is refreshing and commendable.

THE half-tone process as a means of effective illustration is being made good use of by the Chambers Brothers Company, Philadelphia, in a series of pamphlets, showing their various patterns of brick-making machinery. The latest which has come to our notice shows two pugging mills and a clay disintegrator, in a manner that leaves little to be desired.

PRESS-BRICK CONVENTION.

THE annual convention of the general managers of the various branches of the Hydraulic Press-Brick Company of St. Louis was held in that city, beginning with Monday, February 8, and was continued for several days.

The various plants of the company, located in nine different cities, were represented by their general managers.

These yearly gatherings are important to the company from the fact that they bring together representatives of leading industries, covering a large section of the country. The reports of the managers of the general conditions prevailing, as made at the meeting, declare that the outlook for the coming season is very much better than has been experienced in the past two years, and a general revival of the building interests may be fairly expected. Mr. E. C. Sterling and Mr. H. W. Eliot, as president and secretary, respectively, of the parent company, hold the same offices in the various branch companies, and the proceedings of the convention are conducted under their direction. The combined product of the companies represented by these gentlemen, it is said, now amounts to more than 300,000,000 pressed bricks annually, and the capital invested in the various companies exceeds $13,000,000. Mr. G. F. Baker has had charge of the arrangements of the convention, to whom, as well as to the other officers of the company, the success of the meeting was largely due.

Among the interesting subjects for discussion was the "Chemistry of Clays," on which a very able address was made by Mr. W. M. Chauvenet, in which he took up this very broad question, and explained the characteristics of the large number of clays worked by companies in all sections of the country, in their relation to the actual manufacture of bricks. The address was unique, as being probably the most practical lecture on the subject ever given before a similar body.

A NEW THING IN BRICK.

WE have had brought to our notice a novel production by the well-known manufacturers of fire-proof building material, Henry Maurer & Son, 420 East 23d Street, New York City, and believing the same will be of interest to our readers, we give a few of the claims made for it by the manufacturers.

It is a brick which they have named the "Centaur," patented in the United States, Great Britain, Canada, and France, and is claimed to possess the following characteristics: —

It is absolutely fire-proof, yet, while seemingly as hard burnt as a front building brick, and nearly as dense, has the peculiar quality, and one heretofore deemed impracticable in a brick of allowing nails, to be driven into it as closely as one pleases, without either splitting or chipping, and the tenacity inherent in said material is such that after being driven "home" it becomes as difficult to draw the nails as though driven into hard wood.

They are impervious to all weather, and will not disintegrate upon exposure, a failing hitherto associated with porous terra-cotta.

They can be employed jointly with common brick on inside of walls in any and all cases where nailing is requisite, providing a thorough and reliable surface for nailing furring strips to the wall, giving also excellent " grounds " for all trim (hard or soft).

If these claims are substantiated, and we have no doubt they have been, it becomes readily apparent that their use will make a great saving in time, labor, and expense in construction, to say nothing of their other novel features.

INTERESTING NEWS ITEMS.

MESSRS. G. R. TWICHELL & Co. have been appointed the agents of the New Jersey Terra-Cotta Company for New England.

THE AMERICAN MASON SAFETY TREAD COMPANY has made a contract with the city of Boston to apply its non-slipping material to the worn granite steps of all police stations.

THE PERTH AMBOY TERRA-COTTA COMPANY will supply the architectural terra-cotta used in the residence for George J. Gould, Esq., at Lakewood, N. J., of which Bruce Price is the architect.

THE face brick used in building the Yerkes Observatory at Geneva, Ill., were gray in color and not buff, as stated in our January number. They were furnished by the Columbus Brick and Terra-Cotta Company, Columbus, Ohio.

THE new cream-white brick made by the Pennsylvania Enameled Brick Company are a solid body mud brick that give a true ring when rapped with a hammer. Meeker, Carter, Booraem & Co., New York, will handle the output of these bricks.

G. R. TWICHELL & Co., Boston, are supplying an old-gold face brick for the new hotel at Providence, R. I., for which Cady & Co. are the architects. They are also supplying a gray brick for the new block of stores on Massachusetts Avenue, Cambridge, C. Herbert Clare, architect.

THE PERTH AMBOY TERRA-COTTA COMPANY have closed contracts for terra-cotta for the following buildings: Hotel Cheltenham, A. H. Bowditch, architect; Gardiner H. Shaw, builder. Office building, Washington and Bromfield Streets, Winslow & Wetherell, architects; the Geo. A. Fuller Company, builders; both contracts being made through their Boston agents, Waldo Brothers.

WALDO BROTHERS have secured the New England agency for the Atlas Cement Company. This company is enlarging its plant at Northampton, Penn., and will have the largest output of any of the American Portland Cement companies. They will continue to have but one brand and one quality, every barrel of their output carrying a specific guarantee for strength and fineness.

SUCH an indorsement as is given in the following letter, received by the Folsom Snow Guard Company, from F. W. Chandler, Esq., Professor of Architecture, Massachusetts Institute of Technology, and consulting architect on Boston public buildings, is of value, not only to the favored manufacturer, but to the architect and builder as well.

To Whom it may Concern: I have often used Folsom Snow Guards because I consider them better than the rail. The former hold the snow where it falls, while the latter makes the snow bank up with the consequent danger of back water and a wet interior.

F. W. CHANDLER.

THE ZANESVILLE MOSAIC TILE COMPANY have closed the contract through their agents, O. W. Peterson & Co., Boston, for the tiling in the five-story apartment house on Westland Avenue, Boston. Arthur H. Bowditch, architect.

The contract includes the tiling of twenty bath rooms, two porches, two vestibules, two main halls, and twenty fireplaces. The tile selected for this work is designated by the company as the Parian Vitreous Tile, of which they are the sole manufacturers.

THE STANDARD TERRA-COTTA COMPANY have secured through their agents, O. W. Peterson & Co., Boston, the terra-cotta to be used in the Masonic Temple, Pawtucket, R. I., Wm. R. Walker & Son, Providence, R. I., architects; W. T. Dearborn & Son, contractors.

They have also closed the contract for the terra-cotta (gray) to be used in the Odd Fellows' Building, Attleboro, Mass., Alfred Humes, of Pawtucket, architect; Benj. Smith, contractor; and the contract for the terra-cotta (light buff) to be used in a business block now being erected in Pawtucket, R. I., Wm. R. Walker & Son, Providence, R. I., architects; Benj. Smith, builder.

MEEKER, CARTER, BOORAEM & Co. have recently secured two contracts for furnishing the University Library of Columbia College. One contract calls for some sixty thousand brick, including a large number of special brick for the base course in the hall and stairways of the library. These will be furnished by the American Enameled Brick & Tile Company, who are expert at making special brick.

The second contract calls for the furnishing of some thirty odd thousand pure white front brick for the same building, from the output of the Pennsylvania Brick Company, for whom they are agents.

The architects of this work are Messrs. McKim, Mead & White. The builders are Messrs. Norcross Bros.

THE NEW JERSEY TERRA-COTTA COMPANY has now completed the terra-cotta work for the Y. M. C. A. building at Cambridge, Mass., and Masonic Temple, Newton, Mass., Hartwell, Richardson & Driver, architects; the Ninth Precinct Police Station, New York City, John Du Fais, architect; and the Osterweis Building, New Haven, Conn., Brunner & Tryon, architects.

Of new contracts this company has received: stores 37th Street and Broadway, New York City, Hoppin & Koen, architects; warehouse, 455, 457, 459 West 14th Street, New York City, Thos. R. Jackson, architect; apartment house, Pineapple and Hicks Streets, Brooklyn, J. G. Glover, architect; chapel and lecture hall, Van Nest, N. Y., James H. McGuire, architect; apartment house, 65th Street, New York City, Geo. Keister, architect.

W. S. RAVENSCROFT & Co. have recently purchased the village of Daguscahonda, Penn., together with a large clay bed of several hundred acres which adjoins the town. The property was purchased for the purpose of developing the clay deposits located there, and the company are at the present time equipping a large plant for the manufacture of front brick, by the most approved methods. The character of the clay gives them quite a range of color in the variety of bricks produced, varying from the dark mottled shades to old gold, light buff, and the various effects of gray. The company state that it is their intention to make a specialty of their gray and buff bricks, as they have been able to produce particularly desirable shades in this respect, and anticipate that the demands on these two lines alone will equal the capacity of their plant. These bricks are similar to the well-known Ridgway gray and buff that have won such extensive favor during the past two years. The two plants are only a few miles distant from one another, and the clays are said to be identical. The town of Daguscahonda is situated on the Philadelphia and Erie branch five miles east of Ridgway. Mr. Ravenscroft organized and built the Shawmut and Ridgway plants, and is still a stockholder in the last-named company. He is also a director in the Savage Fire Brick Company of Keystone Junction, Penn.

EVOLUTION IN BRICKMAKING.

BURNT clay is the oldest and most primitive of all building materials, and has been used for untold centuries in much the same manner as we use it to-day. But although bricks have always been fashioned out of clay, the evolution from the primitive brickyard, with its crude appliances and laborious manual devices, to the modern plant, with its highly organized mechanical equipment, is a development of the past two generations, and brickmaking at the close of the nineteenth century can be classed as an exact science, representing results of long and costly experiments, and calling for investments of capital and vastness of operations on a plane with the largest of American enterprises. The extent of the development of brick manufacturing is well illustrated by the plant of the Sayre & Fisher Company, at Sayreville, N. J., which was originally established in 1851, by Jos. R. Sayre, Jr., and Peter Fisher, who remained in partnership until 1887, when the firm was incorporated as a stock company, with Jos. R. Sayre as president, Peter Fisher as treasurer, and E. A. Sayre as secretary, and has continued since that time without any change in the management. The manufacture of brick was begun at this plant in 1852. Only 3,000,000 common bricks were produced the first year, whereas in 1896, 73,000,000 bricks of all kinds were turned out, and the daily consumption of clay and sand, which in 1852 was about 75 tons, rose to 1,000 tons in 1896.

The company controls over a thousand acres of clay beds. A force of from six hundred to eight hundred men is employed in buildings which are fully equipped with modern machinery, exclusively devoted to the manufacture of brick, and extend along the full length of the frontage on the Raritan River, with a wharfage a mile in total length, from which the output is shipped directly by water or by rail to any part of the world. All the Sayre & Fisher common bricks are made by the soft mud process, while the stiff mud process is used for front bricks, the regulation machinery being utilized for each.

THE QUEEN INSURANCE COMPANY'S BUILDING, CEDAR AND WILLIAMS STREETS, NEW YORK CITY.
W. A. & F. E. Conover, Contractors. Harding & Gooch, Architects.
Brick furnished by Sayre & Fisher Company.

As the front bricks are the ones in which most of our readers are presumably the more interested, we would briefly explain the stiff mud process as follows. The clay, after being thoroughly seasoned, is mixed dry, then run through crushers, where it is pulverized, then through a "wet" mixer, where it receives additional mixing, then through a die, to form the clay into the proper shape for cutting, thence being delivered to a machine which cuts it into bricks of the required thickness. The bricks so formed are then subjected to a heavy steam pressure, then dried by hot air, then burned in the kilns. The ordinary down-draft kilns are used, of which there are sixty-three in all, with a capacity running from 30,000 to 600,000 bricks, the average capacity being about 300,000 bricks. The process of manufacturing is in every way facilitated by the adoption of the best approved machinery, every stage of the work having its particular appliance. From the loading of the clay on the cars by the steam shovel to the transfer of the burnt bricks from the kiln there is everywhere employed the best possible device to save labor, and with a view to still further economy of labor the company has recently, at a great expense, equipped its entire plant with electricity.

The clay banks of the company contain no less than eighteen different kinds of clays, and hence it can produce a great variety of shades in brick, not by artificial coloring matter, so apt to fade, but by the careful selection, intermixture, and burning of the clays. The annual output of the plant is over 73,000,000 brick. Of this some 64,000,000 are common, and the remaining 9,000,000 face and enamel brick.

The Sayre & Fisher Company was among the first, if not absolutely the first company, to offer a variety of shades in brick. The first departure from the ordinary "red" was a gray buff, which was put on the market in 1863. This was the first buff brick made in New Jersey, and used to easily bring sixty dollars per thousand. The company at the present time is making white, buff, red, gray, brown, old gold, mottled, and all the intermediate shades of brick, and these have acquired for themselves an enviable reputation for holding their color and being hard and fire-proof in character.

The enamel brick department is of a size and character in keeping with the vast proportions of the rest of the plant. The method employed here is what is known as the English process, wherein the enamel is placed on a fire-brick body and burnt with one firing. The number of shades which the company manufactures and keeps in stock, as illustrated in their catalogue, is over twenty-eight. This gives a wide range for selection in the choice of color.

Nearly all of the machinery used in the works is manufactured by the company in a large machine shop of its own. All of the departments are kept in the most thorough working order, so that the vast organization operates with a smoothness and uniformity which makes possible the uniform excellence of the output. The attention to detail which the company shows is evinced in the consideration given to the men in its employ. Among its thousand or more employees there is a large proportion of single men, and for their benefit the company has erected a large building which is to all intents and purposes a regulation club house, in which the men can sleep and have their meals, and where they can enjoy, with some necessary restrictions, all the comforts and privileges that men desire in a well-equipped club.

The New York office of the company has been since its establishment, seven years ago, under the efficient management of Mr. A. J. Fletcher. The large and ever-increasing sales in the New York market, of brick made by this company, testify to the genuine merit and popularity of the output, combined with the energetic and conscientious management of the department through which this output is sold. The company has branch offices in Baltimore, Philadelphia,

BOWLING GREEN BUILDING, NEW YORK CITY.
W. & G. Audsley, Architects.
White brick furnished by the Sayre & Fisher Company.

Buffalo, Newark, Chicago, and Boston, and in all of these cities the number of Sayre & Fisher bricks used annually is rapidly increasing, and deservedly so.

The list of large and prominent buildings in which Sayre & Fisher bricks have been used is so long that we can only cull from it a few of the most well-known structures.

NEW YORK.

Bowling Green Building	800,000 white brick.
Cable Building	500,000 ,, ,,
Bank of Commerce	400,000 cream-white brick.
Lord's Court Building	500,000 gray brick.
Central National Bank Building	300,000 ,, ,,
St. Luke's Hospital	300,000 white enameled brick.
American Surety Building	80,000 ,, ,, ,, and 115,000 light-gray brick.
Presbyterian Building	40,000 white enameled brick.
Manhattan Life Building	140,000 buff brick.
Mutual Life Building	160,000 ,, ,, and 40,000 gray brick.
The Dakota Apartment House	360,000 buff brick.
Colonial Club	60,000 ,, ,,
Museum of Natural History	30,000 ,, ,,
Life Building	30,000 ,, ,,
Metropolitan Museum	200,000 ,, ,,
Fifth Avenue Theater	25,000 ,, ,,
Manhattan Athletic Club	80,000 ,, ,,
Residence of Mrs. W. K. Vanderbilt	45,000 mottled brick.
Central Building	250,000 old gold ,,
Taylor Building	185,000 ,, ,, ,,
Postal Telegraph Building	160,000 gray brick.

BOSTON.

State House Extension	200,000 buff brick.
Castle Square Theater	120,000 white brick.

In a general way it can be said that the Sayre & Fisher bricks are used very largely throughout the Eastern, Middle, Western, and Southern States.

A very good view of the company's extensive plant is shown in their advertisement on page xvii.

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CLINTON & RU

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CLINTON & RUSSELL, ARCHITECTS.

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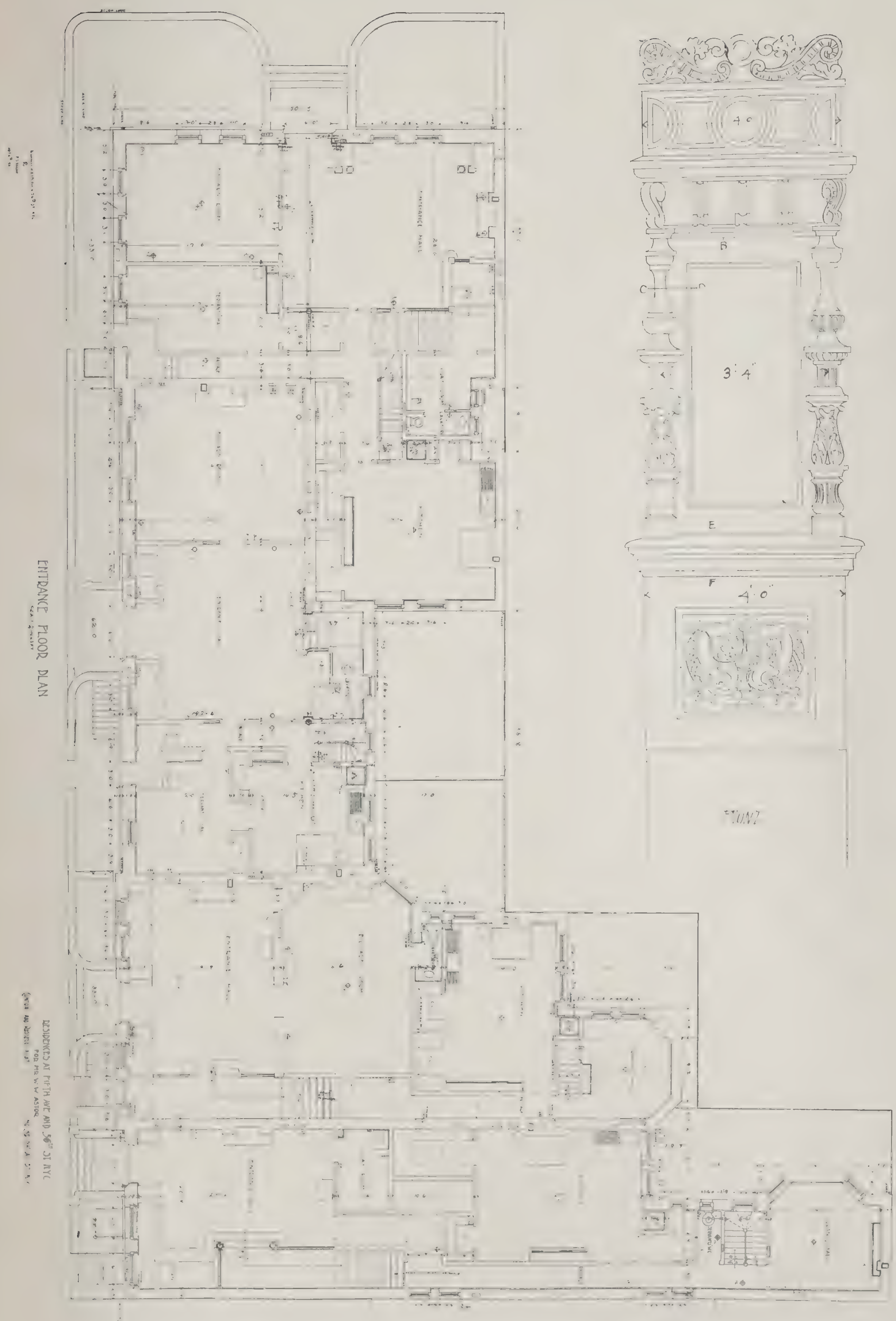

First Floor Plan.

DETAILS OF CHIMNEYS, WINDOWS, AND GA

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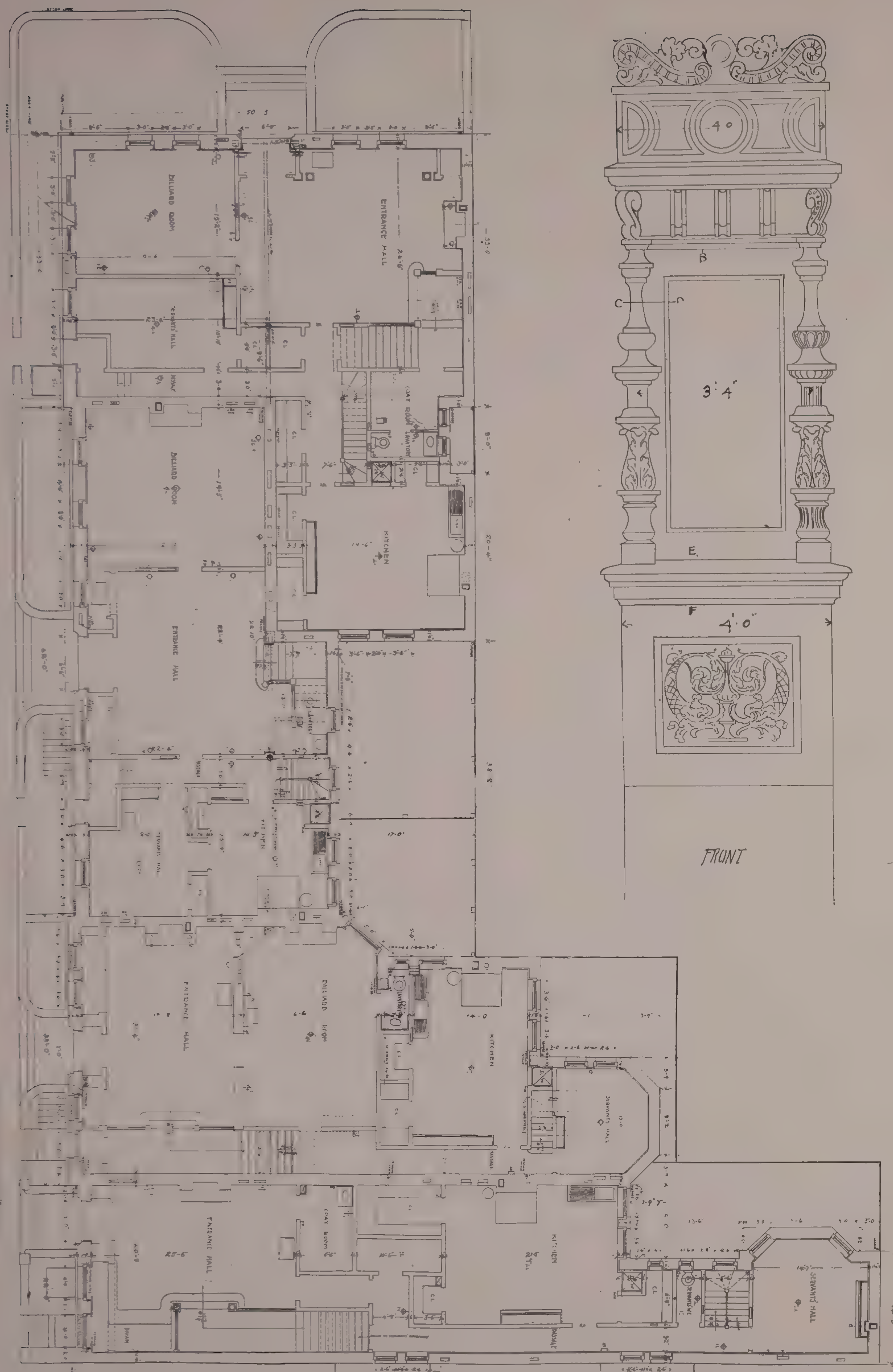
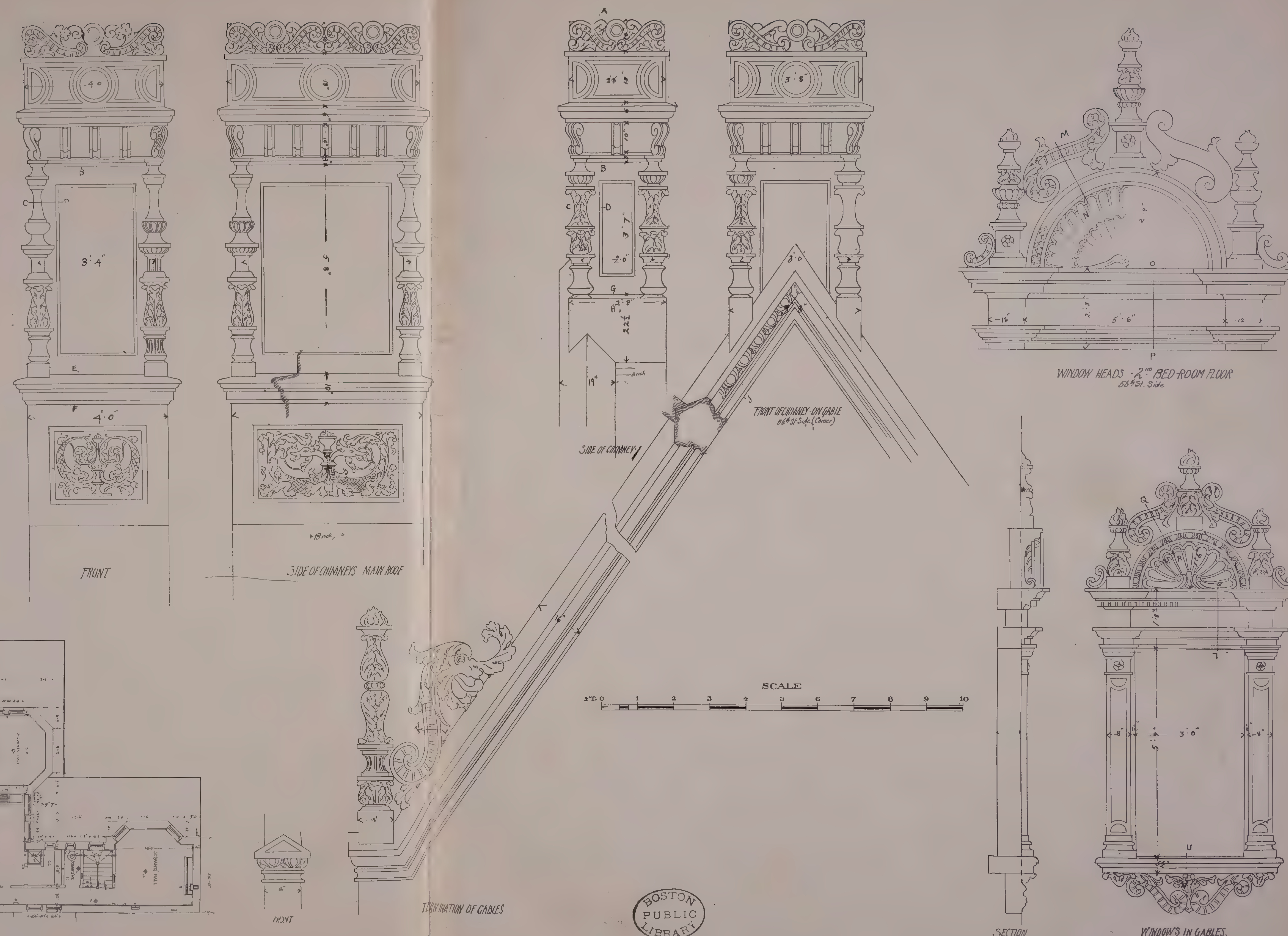


First Floor Plan.



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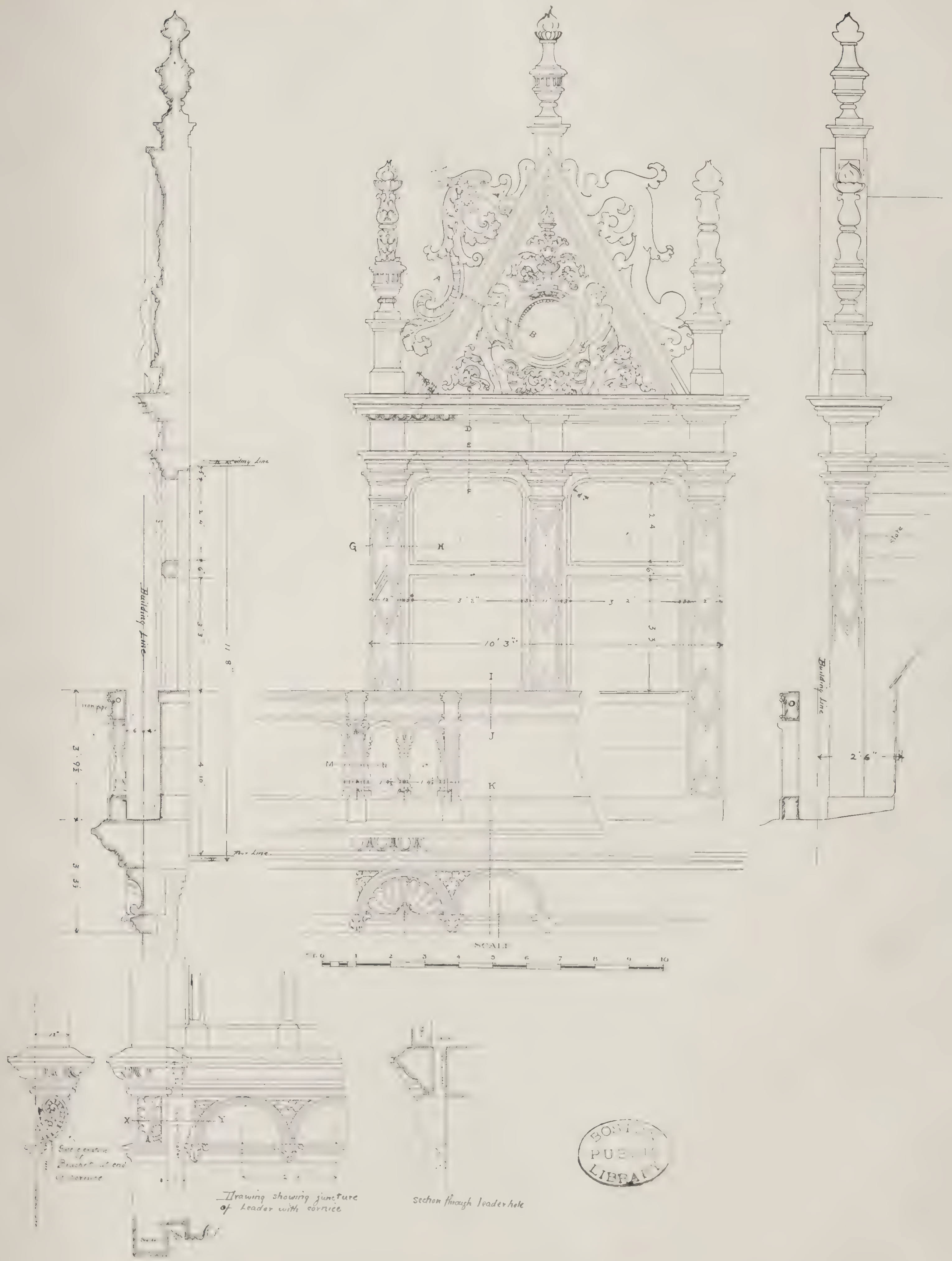

DETAILS OF TERRA-COTTA DORMER, Etc.

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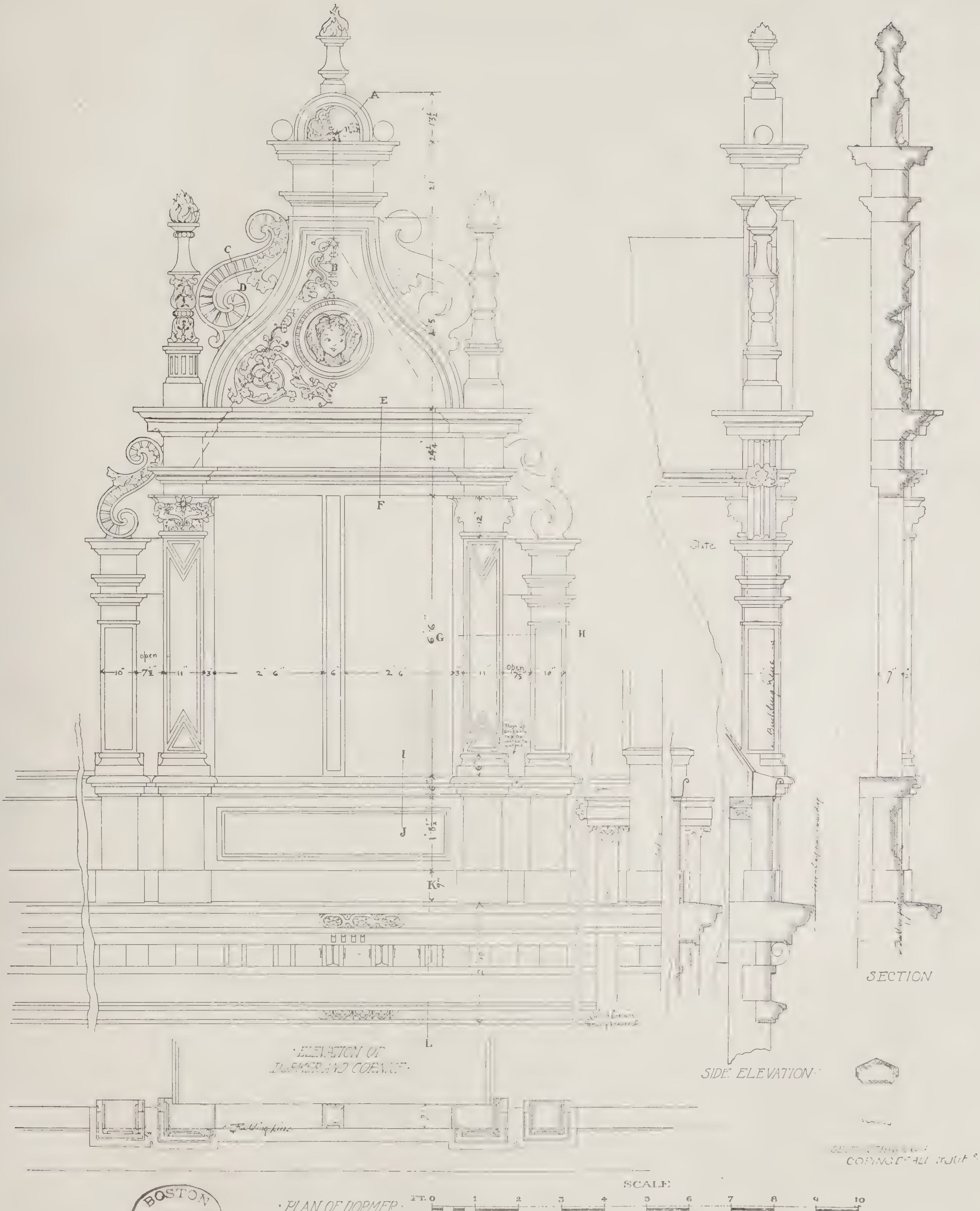

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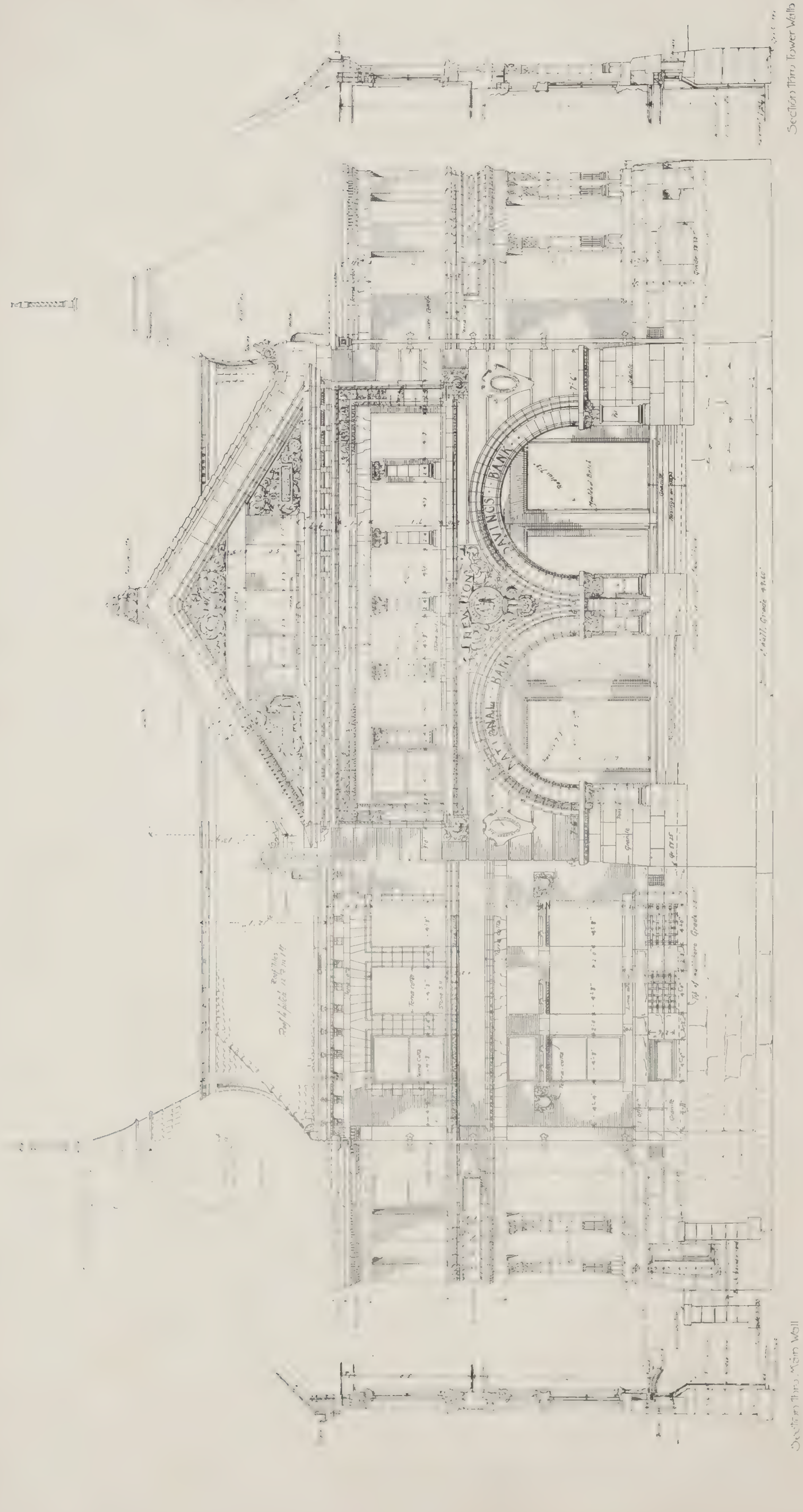
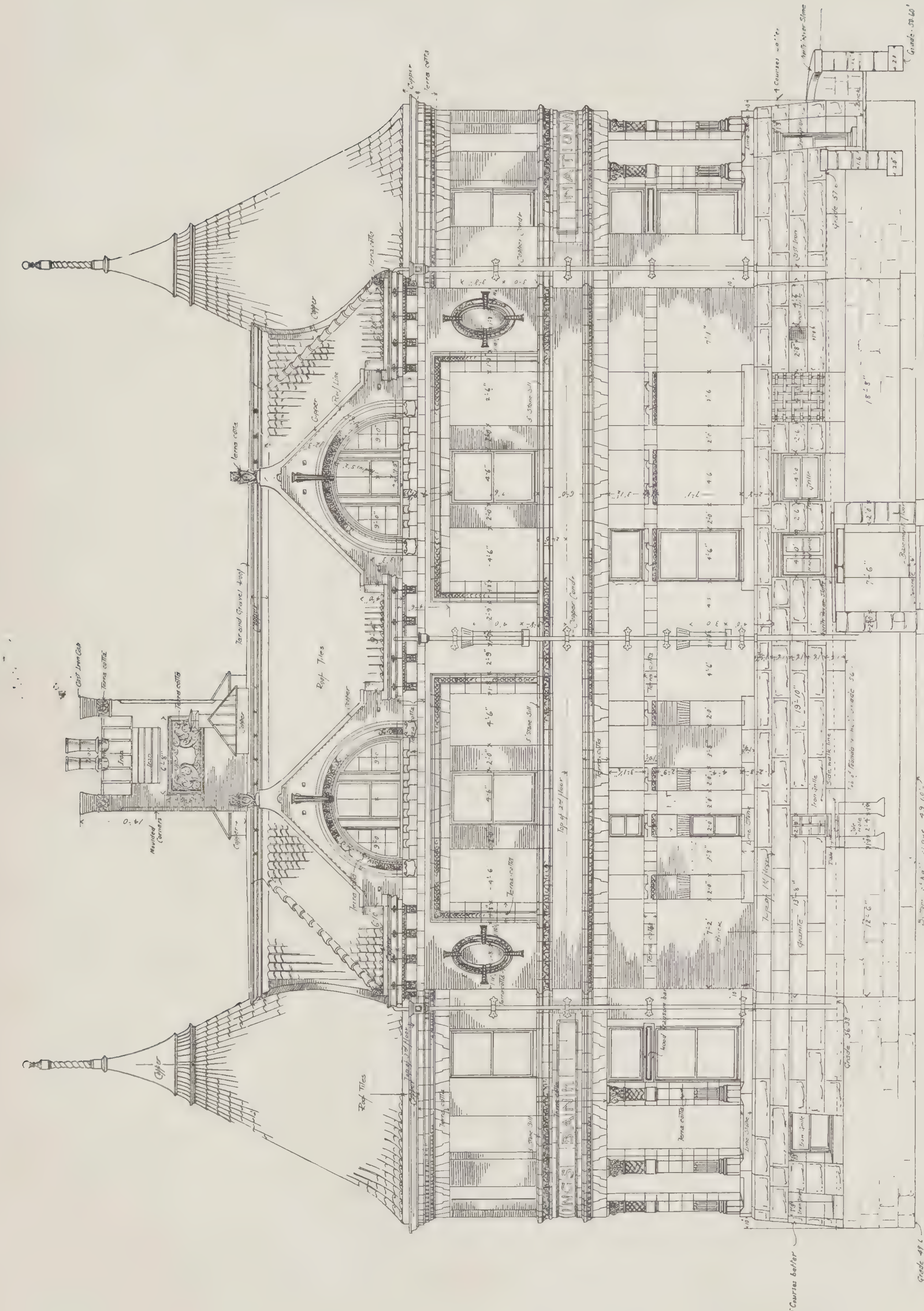


BANK BUILDING, NEWTON, MASS. FRONT ELEVATION.

WILLIAM G. PRESTON, ARCHITECT.



BANK BUILDING, NEWTON, MASS. Side Elevation.

WILLIAM G. PRESTON. Architect.

VOLVME VI MARCH 1897 No. 3

THE BRICKBVILDER

OFFICE 85 WATER STREET BOSTON

THE BRICKBUILDER.

AN ILLUSTRATED MONTHLY DEVOTED TO THE ADVANCEMENT OF ARCHITECTURE IN MATERIALS OF CLAY.

PUBLISHED BY

ROGERS & MANSON,

CUSHING BUILDING, 85 WATER STREET, BOSTON.

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NOT long ago there occurred in this city one of those lamentable accidents which are of unfortunately only too frequent occurrence in our large cities, and which, in nearly every case, are so needless and could apparently have been so easily prevented that it is hard to have any toleration for the conditions which directly or indirectly lead up to them. In the Everett School, as the pupils were being dismissed, smoke was seen issuing from one of the rooms and an alarm for fire was raised, with the result that in their blind, unreasoning haste to escape from a possible danger, a panic seized the children and they were crowded together at the foot of the stairs leading to an inadequate exit to such an extent that many of them were badly injured, and it seemed for awhile as if very serious results would follow. The fire proved to be confined to a waste-basket, and was promptly extinguished by one of the teachers, but the occurrence itself, coupled with the fact that the schoolhouse is in no sense modern in its construction, ought to be the means of arousing a more decided public sentiment which would compel municipal authorities to adopt a better and more secure construction for every schoolhouse, no matter where located, or under what surroundings. There is no excuse in these days for the existence of a schoolhouse which under even the most extreme cases is liable to destruction by fire. If the Everett School had been built according to modern methods, with terra-cotta floors, steel beams, solid furrings, and as far as possible a total absence of wood, it is quite within the bounds of possibility that the pupils might even then have been seized with a panic, and quite as much harm might possibly have ensued; but the moral influence upon the children of knowing that they are in a fire-proof building would naturally tend to lessen their liability of becoming excited upon an alarm of fire, while the chances are that if our municipal authorities should insist on all occasions upon a fire-proof construction, it would mean as a consequence more care devoted to arrangement of the schoolhouse, with the probability that better staircases and better exits would be provided and the likelihood of any occurrence such as we have cited would thereby be greatly lessened. It is no excuse to say that the Everett Schoolhouse was provided with fire-escapes. It has been said with perfect truth that only a person of mature mind and well-balanced head is competent to successfully descend even our best constructed external fire-escapes, and children are as likely to meet death on an iron fire-escape attached to the exterior of a building as they are to be overcome by the conflagration within. We do not by this imply that fire-escapes should be omitted; on the contrary, they should be provided, but on a much more ample and secure scale than is adopted at present, and instead of being aerial balconies perched on the exterior walls, they should consist of thoroughly fire-proof stairs enclosed in brick walls, with the access to each story cut off by self-closing fire-proof doors, the landings being of sufficient size to accommodate the greatest number of pupils that might use the stairs.

The fire-proofing of schoolhouses is a point which cannot be too strongly insisted upon. The trend of modern thought is entirely in this direction, and in our larger cities nearly all of the recent schoolhouses have been constructed on fire-proof lines. A few years ago the so-called slow-burning construction was advocated for schoolhouse floors, and a number of very fine buildings have been erected in accordance with this system. But however slow the combustion may be, it remains a fact that wood in any form is in no sense fire-proof, and that though the wooden beams may burn for quite a while without actually failing, it takes a very little wood to make a deal of smoke, and the moral effect on the pupils is what is to be most carefully considered rather than the ultimate resistance long after the building itself is uninhabitable. Wood in any form should be seduously avoided. With the floors constructed of steel beams and terra-cotta blocks, with mosaic or terrazzo finish for the floor surfaces throughout, with plastering applied directly to the masonry, and all partitions of terra-cotta or brick, a schoolhouse would be more durable, easier to keep warm in winter and cool in summer, would cost less for repairs, and the moral influence it would exert upon the students would in a very short time be such as to give them sufficient confidence to see a blaze start in one room without necessarily rushing panic-stricken to the nearest exit. It is contrary to all experience, contrary to the best interests of the community, and in the long run contrary to true economy, to build a schoolhouse with wooden floor construction; while as for schoolhouses constructed entirely of wood, they ought not to be tolerated anywhere, and the use of such where they exist ought to be immediately discontinued by the public authorities.

In this connection we regret to note the report that one of our neighboring cities is about to commence the erection of a Latin high school, costing upwards of $200,000, in which the entire floor construction is to be of ordinary narrow wooden beams, and in which the partitions, though mostly of brick, are carried only to the ceiling of the upper story, leaving a large roof space undivided by brick walls. This is so fundamentally wrong that we can only hope our information may be incorrect, or that the authorities in charge may substitute steel and terra-cotta before it is too late. The introduction

of so-called fire-proof paper between the upper and under floor boards is too insignificant a protection to be even considered. We repeat that the danger in a schoolhouse lies not so much in the total destruction of the edifice as in the possible destruction of life ensuing from a panic on the part of the pupils. The life of a single boy or girl is worth too much to be put at a risk on account of false economy, and so long as there is wood used in the construction of a schoolhouse, just so long are we liable to a recurrence of disasters similar to that in the Everett School; and until the parents can feel that their children are attending school under conditions abreast with the most intelligent thought upon the subject, just so long our school committees will continually fail to meet and properly provide for the fulfilment of a manifest duty.

THE PALAZZO FAVA, BOLOGNA.—PLATE 32.

THE Palazzo Fava is one of the largest and finest palaces in Bologna. Its finely proportioned brick façade of two stories carried on a graceful arcade is decorated with delicate red terra-cotta ornamentation around the windows and arches, and a strong cornicione at the top. As in most Bolognese buildings, the upper stories are carried out to the curb line, the ground floor being arcaded to form a covered sidewalk. The mullion columns of many of the windows have been cut away to make room for modern window frames, but several are left intact and are among the most interesting in Bologna. Inside there is a handsome court, the upper stories of which on one side are carried on handsome Renaissance corbels. The columns both of the court and outer arcade are built of rounded brick with carved stone capitals.

PERSONAL AND CLUB NEWS.

THE Tenth Annual Exhibition of the Chicago Architectural Club opens at the Art Institute, Tuesday evening, March 23.

A. WARREN GOULD, architect, Boston, has removed from the John Hancock Building to 2 A Beacon Street.

A. W. PUTNAM, architect, Dayton, O., has formed a copartnership with Frank L. Sutter, the firm name being Sutter & Putnam. Offices, Louis Block, Dayton, O.

AT the Chicago Architectural Club, on the evening of February 26, Mr. Hugh M. Garden read a paper on "Style," prepared by Mr. John W. Root for the club ten years ago.

On the evening of March 8, "Bohemian night" was observed, Messrs. Herbert Edmund Hewitt, Harry Dodge Jenkins, and E. Greble Killen being the hosts.

Monday evening, March 22, was Ladies' Night at the club, a reception being tendered the lady members of the Ceramic Club, who in turn served refreshments during the evening.

THE regular meeting of the New Jersey Society of Architects was held on March 12, at the Board of Trade Rooms, Newark. All sections of the State were well represented, and subjects of general interest were discussed. Three new members were added, Messrs. Brouse, Arend, and Poland, all from Trenton.

The entertainment committee announced that the annual banquet would probably be held in April. The association has permanently engaged the Board of Trade Rooms as a meeting place. Mr. John H. Post was elected to fill a vacancy in the trustees. A committee to obtain, by competition, an association seal, was appointed.

SATURDAY night, March 6, was Poster night at the St. Louis Architectural Club. There was a good collection; among them a number from Paris, exhibited by Mr. Ernst Klipstein. There were also a number of original designs by members of the club, of considerable merit. Among them one entitled "After the Symposium," *i. e.*, after returning home, by Mr. Ben Trunk. Also a very excellent one by Mr. Oscar Enders.

A number of visitors from the local chapter of the A. I. A. were entertained during the evening.

Messrs. Manny, McArdle & Ramsey acted as judges in the competition for a water tower. Mr. Ernst Helfensteller was given first place.

THE Detroit Architectural Sketch Club will hold, during the spring months, several competitions which are open to members only. The regular meetings of the club take place on Monday evenings of every week. The officers of the club are Emil Lorch, president; Geo. H. Ropes, vice-president; Edward A. Schilling, secretary; Richard Mildner, treasurer. Directors, Alex. Blumberg, W. E. N. Hunter, M. T. Wilcox.

ILLUSTRATED ADVERTISEMENTS.

THE New York Architectural Terra-Cotta Company send for illustration the upper portion of tower on Grace Church Mission Buildings, East 14th Street, New York City. Messrs. Barney & Chapman were the architects.

Trinity Memorial Church, Binghamton, N. Y., Lacy & Bartoo,

architects, is shown in the advertisement of Charles T. Harris, Lessee, page xxvi.

The Synagogue at New Haven, Conn., Brunner & Tryon, architects, is shown in the advertisement of the New Jersey Terra-Cotta Company, page ix.

The New Central High School Building, at Detroit, Malcomson & Higginbotham, architects, is illustrated in the advertisement of J. B. Prescott & Son, page xxxvi.

Spanish Brick and Tile Work. V.

BY C. H. BLACKALL.

THE picturesque qualities of Spanish architecture are due in no inconsiderable degree to the effect of the tiling which is used throughout nearly the whole of the peninsula for covering the roofs. Tile roofs of the same general description are found to greater or less extent throughout Italy, and in a few cases, in other parts of Europe; still the semi-cylindrical form of the dull, unglazed tile is more generally associated with Spanish work than with that of any other country, and if not a direct development of Spanish thought, it has certainly found a very large application in Spanish construction. The fringed, scalloped effect produced along the eaves by the use of these tiles is a very pleasing break in the sky line of a building which aims to be picturesque, and the color, which is almost invariably of a light red, adds a great deal to the effect. Tile roofs are used indiscriminately upon all classes of buildings. The illustration of the Antigua, at Valladolid, shows the picturesque effect of these tile roofs in a very striking degree, and the combination of the strong tones of the burnt clay with the clear, tawny shades of the stone, and the deep, rich purple shadows which are always a part of Spanish buildings, give a delightful charm to this old structure, and though the walls are themselves of stone, the terra-cotta plays a very considerable part in the effect. The lower roofs are covered with the semi-cylindrical tiles, and the view shows a very good general average of the way in which these roofs look after they have been repaired a few times. The tiles themselves are quite soft, so much so that in walking over a roof one is very apt to break a tile at nearly every step; but in Spain, where the rains are neither copious nor long continued, the easy-going inhabitants do not seem to consider this as a great calamity, and besides, it is so easy to patch one of these roofs by simply inserting a tile at intervals that the break is soon remedied. So far as I have been able to discover, such a thing as flashing is little known, and the tiles, after being carried up from the eaves in a more or less direct manner to the side walls or the apex of the roof, are literally swathed in good cement mortar, and if the side walls are to be stuccoed the cementing is carried up on the walls, so that to judge by external appearance these roofs, though very irregular and unworkmanlike in appearance, answer every purpose of protection. The very irregularity, which from a utilitarian point of view might be deplored, is an added element of charm to the artist, and the scalloped eaves throw long, irregularly fringed shadows on the walls below in a manner which would be impossible with any other construction. The tower of the Antigua itself is covered with flat tiles, laid in much the same manner as our slate.

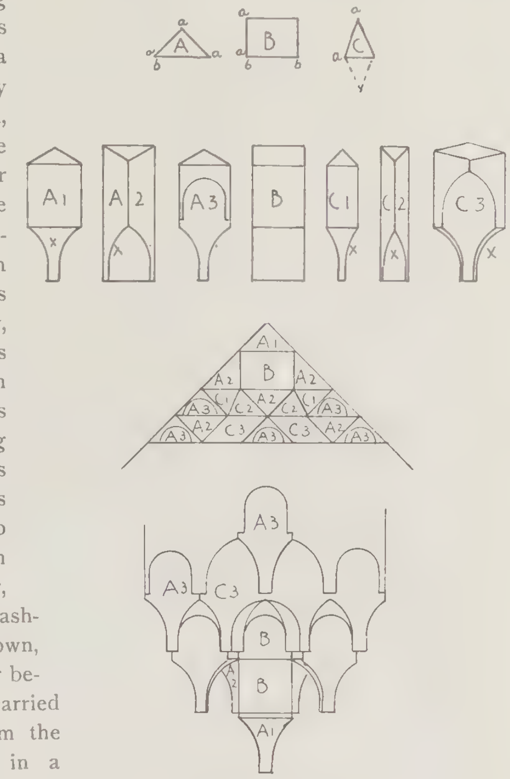
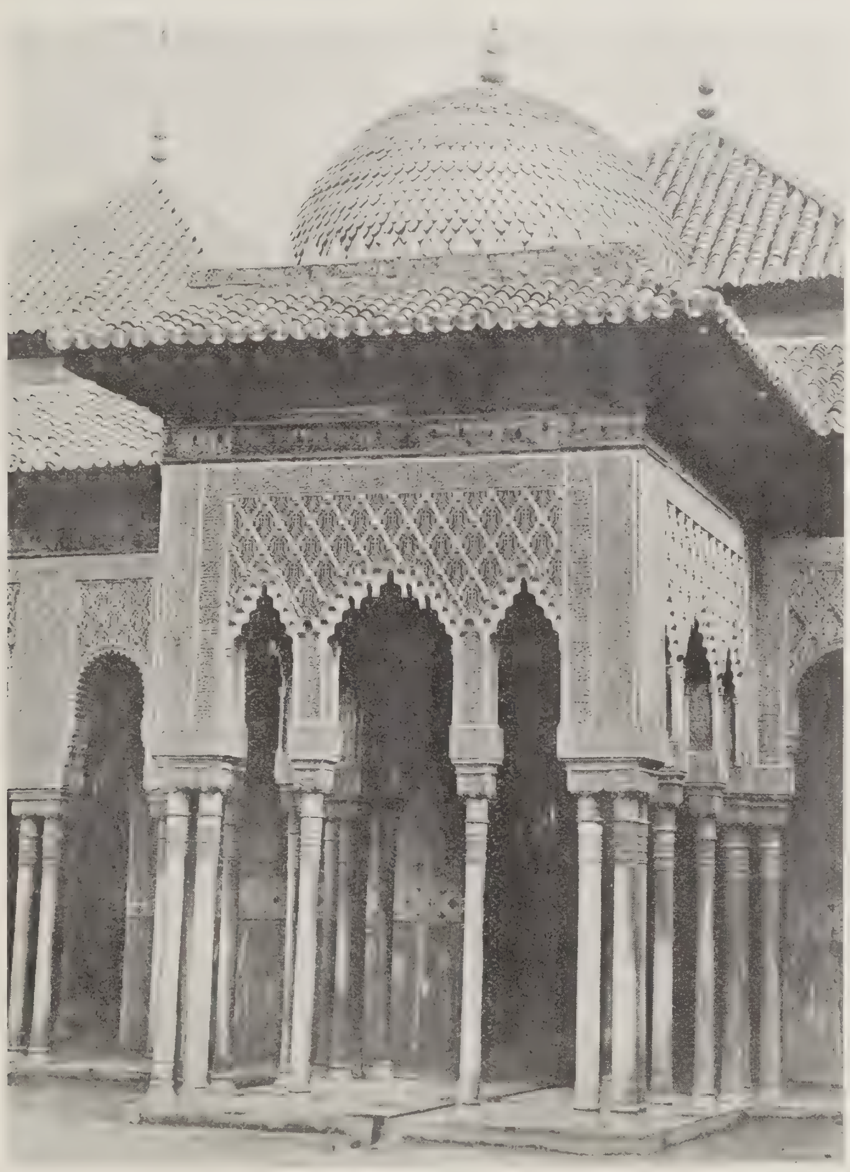


DIAGRAM SHOWING COMPOSITION OF STALACTITE WORK.

The porch of the Court of the Lions is an admirable example of what is done with the Spanish roofing tiles. Of course this roof has been thoroughly restored and repaired, and as the buildings are not in actual use and are subjected to a careful oversight, these tiled roofs have a finished, workmanlike appearance which is, on the whole, rather un-Spanish. The usual experience is to find the tiles so broken and patched that the surface is very much cut up and has a texture-like effect which is eminently picturesque, even if not a sign of first-class repair. A narrow band of colored tile is introduced below the base of the dome immediately over the eave tiles, and is capped by a row of the peculiar cresting tiles which are so often found in Moorish work, with a zigzag palm-leaf pattern. The effect of the vivid color interposed between the two masses of dull tilework is very striking and effective.



PORCH OF COURT OF LIONS, ALHAMBRA.

The view of Toledo from the Alcazar consists principally of roofs, and illustrates the various ways in which a simple tile unit can be used on different slopes and under different circumstances. The secret of the durability of a roof of this kind, of course, lies in the fact that there are no surfaces for the water to remain in, there is no snow and ice to work under the tiles, and cement is used very

liberally throughout. Tiling of this description has been manufactured to a certain extent in this country, but has never met thus far with the encouragement which it deserves. Our climate is, of course, against it to a considerable extent, but climatic disturbances can be provided for, and there seems to be no good reason why we should not avail ourselves of this excellent aid in general color treatment of a building.

TOLEDO FROM THE ALCAZAR.

The Collegiata at Toro is roofed entirely with semi-cylindrical tiles. The roof has stood so long, and has been repaired so often, that it is at present in a most delightfully artistic state of delapidation, and when I visited the church a few years ago and had occasion to walk across the roof to measure the tower, I found the tiles were so friable that two or three of them would crush with every step I took. This did not seem to at all alarm the custodian who accompanied me, and he seemed to think a few broken tiles more or less a very slight matter easily obviated by a few trowelsful of mortar.

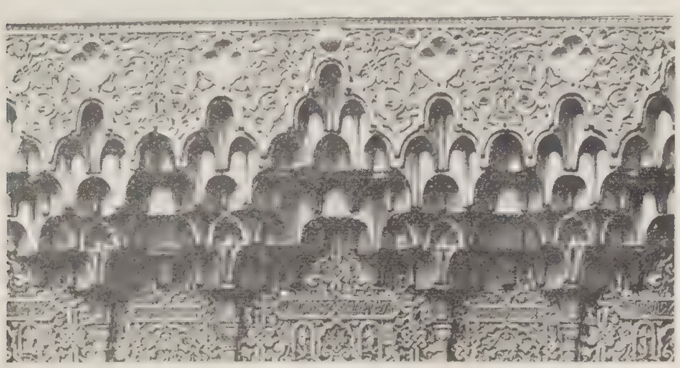
THE COLLEGIATA, TORO.

In the south of Spain along the Mediterranean coast, where the Moorish element has been most marked in its influence, there are several very interesting examples of enameled or slightly glazed roofing tiles, usually flat rather than semi-cylindrical, and in some cases worked out in color. The tiles in this part of the country are also very much darker red than those in the north, and are made of much stronger material.

There is a species of decorative treatment which is peculiar to Moorish work, and in fact has been used by no other race. It is the decoration of vaulted surfaces forming what is known as the stalactite vault. The illustration from the Alhambra will show the appearance of the work. This same treatment is often carried entirely across quite large rooms, forming a delightfully complex ceiling, which at first sight has the appearance of a maze of frost work, though closer examination shows it is constructed strictly upon mathematical principles. It is composed of numerous prisms of plaster which are united by their contiguous lateral surfaces, there being seven different forms of blocks proceeding from three primary figures in plan. They are, by reference to the accompanying diagram, the right angle triangle *A*,

the rectangle *B*, and the isosceles triangle *C*. In these the sides *aa* are equal, *ba–bb*, and the vertical angle of *C* is the same as the lesser angles in *A*, or 45 degs. The figure *B* has one form in section, the figure *A* three, and the figure *C* three, the third figure, *C*3, being a rhomboid formed by the double isosceles triangle. The curves marked *x* of the several pieces are similar. By this it will be seen that a piece can be combined with any one of the others by either of its sides, thus rendering the blocks susceptible of combinations as various as the melodies which may be produced from the seven notes of the musical scale. So far as I know, this kind of work has never been successfully copied outside of Spain. It is probably a development from brick construction. This, however, is only a theory based upon the manner in which the individual blocks are used, upon the appearance of the work when finished, and upon the fact that it would be a not unnatural development of the attempt to cover

LA ANTIGUA, VALLADOLID.



STALACTITE WORK FROM THE ALHAMBRA.

a room with a brick vault without the use of centering. In the Moorish examples the blocks are usually of plaster and are, of course, set in fresh plaster of Paris. There is no reason why a similar construction could not be applied to terra-cotta or molded brick with most interesting results. A very few patterns would suffice to answer for a great variety of designs, and with a little intelligent oversight a vaulting of this kind could be put up for moderate spans without the need of any centering, using a very quick-setting cement, as when once in place the blocks would key together thoroughly.

Brick Vaults Built Without Centers.

Translated from the "*Anales de la Construccion y de la Industria.*"

BY A. C. MUNOZ.

(Concluded.)

IF the space to be vaulted is very long, it is customary to divide it into nearly square bays, by means of arches built with centers either by the ordinary method or by that of vertical leaves. In this latter case generally only the middle leaf is made vertical, while the other leaves are built in pairs on both sides of the first, and increasing their inclination in each succeeding leaf until the desired inclination is reached. The vault is then completed as explained above.

By whatever method these dividing arches are built, the construction of the vault must proceed from both sides simultaneously, so that the thrusts will neutralize each other.

These vaults, as well as those of vertical leaves, may vary in thickness. If the thickness is equal to the length of a brick, the bricks may be laid as shown on Figs. 10 and 11. If the thickness is one and a half bricks, they may be laid as shown in Figs. 12 and 13. The vault may also be built in separate concentric rings, which method is preferable when the thickness exceeds the length of the brick, for the reason that the joints do not then open so much at the extrados, and further, the labor of filling the joints a b c (Figs. 12 and 13) with chips of stone or brick is avoided. The lime from Badajoz is of very good quality, and when used in making the mortar, the inclination of the leaves is generally increased beyond 45 degs., which is the limit for ordinary mortar.

In Extremadura most vaults are constructed in the manner last described, and are used in wells, cellars, basement rooms, and in farm-houses in which the upper floors are used for granaries. They are made more or less decorative by varying their forms, etc.

The advantages of being able to build vaults with ordinary mortars and without the use of centers are so obvious that it is not necessary to enumerate them.

GROINED AND CLOISTERED VAULTS.

The construction explained in the last chapter may be applied to a groined vault as follows: —

Let a, b, c, d (Fig. 14) be the space to be vaulted; as in the previous cases, grooves determining the curvature of the intrados are cut in the walls; then the corners a, a′ a″ a‴, b, b′ b″ b‴, c, c′ c″ c‴, d, d′ d″ d‴ are first built by laying the bricks as for an ordinary vault and until their faces reach an angle of 38 to 45 degs. From this point the construction is changed. To do the work properly four bricklayers are needed, who, placing themselves each in front of one of the walls respectively, fill in the spaces a′ a″ e and c‴ c″ e, a‴ a″ e′ and b″ b‴ e′, b′ b″ e″ and d′ d″ e″, d″ d‴ e‴ and c′ c″ e‴, setting the bricks in courses as shown by a″ e′ b″, b″ e″ d″, etc. This construction is carried on until the vault is closed, each mason building his portion as if it was a barrel vault, and when near the vertex, when the workmen would interfere with each other, the construction is carried on from the outside. Of course, at the groins the bricks have to be cut, and care should be taken to well bond the bricks which form the groins.

The construction is guided by two strings stretched between the vertices of opposite arches, as e e″, e′e‴ (Fig. 14), marking the highest points of the vault, and by five plumb lines, to determine the plane of the groins; one at C (Fig. 14, Plan), the intersection of the diagonals; the other four also on the diagonals but near the springing points, as at a a″ b″ c″ d″. The plumb lines of opposite angles together with the one at the vertex determine the plane of the corresponding groin, the curvature of which is generally given by the eye. This requires skillful workmen, and to facilitate the work the lightest kind of frames having the desired curvature may be used, and thus obviate the irregular groins which are very common in this kind of vaults.

In the construction of groined vaults of this kind for a factory recently built in Badajoz, the engineer determined the curvature of

the groins by using four strings, which, being stretched in pairs from opposite points of the head arches, and in the same horizontal plane, were thus elements of the barrel forming the vault, and therefore the intersection of these strings were points of the groins. By increasing the number of strings great accuracy may be obtained in determining the curvature of the groins.

CLOISTERED VAULTS.

The construction of this kind of vault is very similar to that of a groined vault.

Suppose a b c d (Fig. 15) to be the space to be vaulted. Having cut grooves on the walls determining the curvature of the vault and beginning at the four corners simultaneously, the portions a p e-p c f

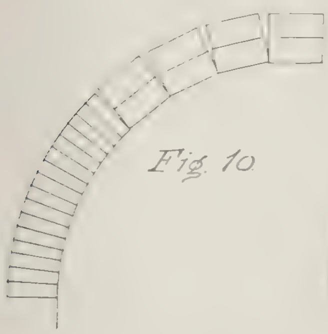


Fig. 10

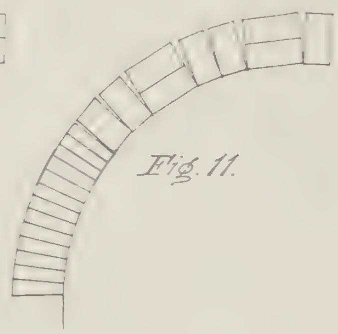


Fig. 11

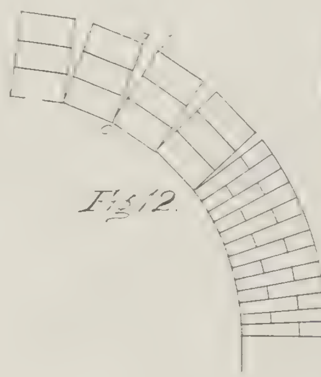


Fig. 12

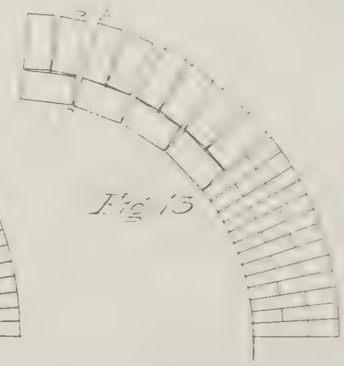
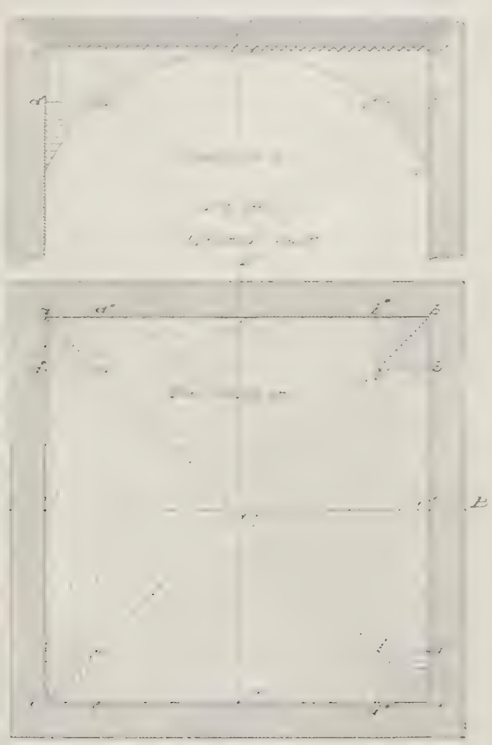


Fig. 13

and b g q-d h q are built first. Then between these, the portions i e r-r g o and l f s-s v h are built, after which the other courses are similarly built in alternating series, as i k l m, o n v t and k w x n-y m t z.

To close the vault the bricks are cut to a wedge shape, as the key of the vault is a truncated pyramid.

The construction is guided by a straight edge M-N placed



between opposite walls at their middle points and above the apex of the vault, and by two strings p-q and r-s stretched between the vertices of the springing arches a r b-c s d and a p c-b q d. Their points of intersection V, which marks the vertex of the vault, may be made higher or lower by means of the string V'-j attached to the middle of the straight edge M-N, and according to the desired camber.

The two greatest advantages of vaults built without centers are the rapidity of their construction and their small cost. Below is given the average cost per square meter, in Spain, of a vault 14 c. m. thick, as deduced from several examples.

0.20 day mason's work at 60 cents	$ .12
0.40 day mason's assistant's work at 30 cents . .	.14
70 bricks at $4.50 per 1,000	.31
0.038 c. m. ordinary mortar	.10
10 liters water	.02
Stone for wedges, wear and tear of tools, etc. . .	.07
Total cost per square meter	$ .76

Groined and cloistered vaults cost somewhat more on account of the greater difficulty in their execution, but with skilled workmen it is safe to say that the cost per square meter would not exceed 80 cents. Comparing these prices with the cost of a center in that part of Spain, it will be found that in most cases the center costs more than the vault.

The following examples will prove the durability and resistance of vaults built as described above.

Within the precincts of the castle of Badajoz there is an old ruined building called the house of the Zapatas, which was purchased in the year 1779 to be used for barracks. All the roofs, the floors, and most of the walls are now destroyed, but a portion remains 13.50 m. long by 5.50 m. wide, covered by a barrel vault which has been preserved intact, notwithstanding the long time which it has been exposed to the weather. This vault has a uniform

thickness of 0.14 m., and is formed by a single thickness of brick. The backing is of masonry and 0.28 m. thick. The springing line is 3.50 m. above the floor, the wall being 1 m. in thickness, while the thickness of the head walls, which are of adobe, is 0.84 m.

In the casemate to the left-hand side of the bastion of Santiago, in the same castle, there are six vaults; one of them is a barrel vault consisting of three sets of superposed rings of curvilinear rows, the bricks in each row being placed with the ends tangent to the curve of intersection of the intrados with a plane forming an angle of 50 degs. with the horizon. The other five are segmental barrel vaults with four sets of superposed rings; the three first sets of rings are laid as in the former vault, with their ends tangent to the curve of the intrados, while in the last or outer ring the faces of the bricks are the tangent ones. The thickness of the vault is 0.90 m. about 3.5 times the length of the bricks; the springing line is 1 m. above the floor with walls 1.70 m. thick, all of ordinary masonry. The vaults have a backing of rammed earth 1.10 m. deep at the crown; over this the upper batteries of the fort are placed. These vaults were built in 1866, and are in very good state of preservation.

In the Normal School a cloistered vault was built in 1866 and has the following dimensions: Span, 7.90 m.; camber of springing arch, 1 m.; height of crown above top of springing arch, .30 m.; thickness of vault, 0.14 m.; thickness of walls, 0.84 m.

In the barracks of San Francisco and military hospital of the same city all the rooms on the ground floor have vaults executed without centers, the rooms in the first floor being used as dormitories for the troops and as hospital wards. These vaults vary in dimensions and in shape; some date from the time of the convent which formerly occupied the site, and others were built between 1853 and 1856. Among these last the most noteworthy of all is a segmental barrel vault 20 m. long, 8.80 m. clear span, and 0.28 m. thick, the springing line is 3.20 m. above the floor and the walls 0.80 m. thick.

In Merida there are many vaults of this kind, some built before the sixteenth century, well preserved; and in those which have been neglected and that the action of time is slowly destroying, the cracks have appeared as one would expect, considering the manner in which the forces act in these vaults. In the old convent of Santo Domingo, in the same city, there is a groined vault in which one of the walls has been destroyed and only the portion of the wall that transmitted strains to that wall have fallen in.

The following fact is worthy of notice: in 1876 the Guadiana River overflowed its banks, inundating the surrounding country and the farmhouses in the neighborhood. In one of these, as in most of them, the ground floor rooms had vaults as those described, the vaults being loaded with grain. The ground floor of this farmhouse consists of four sets of chambers around a central court and forming a rectangle. The main suite, more than 40 m. in length and divided by a few partitions, is covered by two parallel barrel vaults 4 m. span; the vaults are 0.28 m. thick at the springing and 0.14 m. at the crown; the outer walls are 0.84 m. and the central wall between the two vaults was for the greater part of its length built of mold and 0.56 m. thick, strengthened by a few stone quoins and by the stone jambs and lintels of the doorways. The water completely undermined and destroyed the mold, leaving the vaults supported only by the stone quoins and by the stone jambs and lintels, and a large crack started between the two vaults not far from the springing line. To repair the vault a new wall of brick, laid without mortar in order to avoid shrinkage, was built in place of the mold wall. The crack was then filled, and soon afterwards the vault was again loaded with grain and has ever since been in perfect condition. The vaults had been built in 1840. The head wall of one of the vaults was also damaged and two small cracks appeared, separating from the rest of the vault that portion which exerts a thrust on the head wall. After repairing the wall and filling the cracks the latter have not separated.

These examples speak for themselves and sufficiently prove the strength and durability of vaults as built in the province of Extremadura.

Architectural Terra-Cotta.

BY THOMAS CUSACK.

(Continued.)

PASSING from the construction and manipulation which experience has thus far proved most advantageous in terra-cotta columns, we now proceed to a consideration of the work commonly resting upon them. The introduction of iron as an auxiliary support has been suggested in the examples already given; and in those that are to follow, a free use will be made of it wherever necessary or expedient. We are aware of the objections that have been urged against the principle of composite construction, such as we now propose to discuss, but they are all of a purely academic kind, and may be put to rest without extended argument. A bare recital of the stubborn facts of every-day practise, in which iron and steel are being so extensively used to supplement or displace other materials, furnishes a conclusive answer. There is no inherent antagonism between these two materials, which in their natural state are closely allied.

We are willing to admit the scarcity of precedents for the use of iron in buildings of antiquity, but it will not be denied that the present generation of builders are doing their share to supply that deficiency on behalf of posterity. Whether posterity will approve of all that is being done for it, is, of course, an open question, and one which must await an answer from that inexorable tribunal. Meanwhile we shall be content to stand by the assertion, that a material of practical utility, however new, or a new way of using such a one to advantage, however old, should not be allowed to go begging through lack of a precedent. Let them all have a trial, free from trammels that are merely traditional, and in so far as they survive the test of service, the innovation of to-day will become the custom of to-morrow, with a good chance of being cited as a precedent on

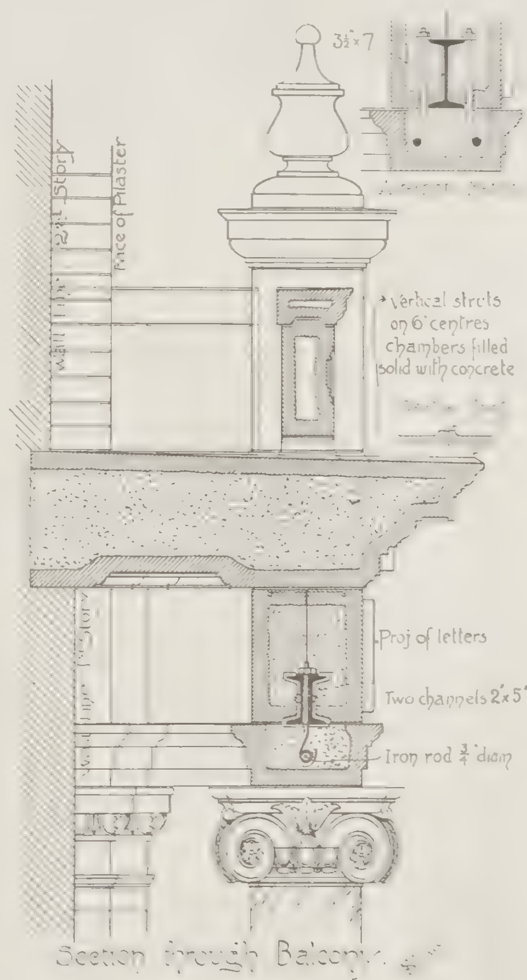


FIG. 15.

the following day. To deny the subsidiary use of iron, as a partial support in terra-cotta construction, when almost everything in the building is in some measure dependent upon it — when in fact the fabric of the building itself is often largely composed of it, would indeed be "straining at a gnat and swallowing a camel."

The constructors of past ages did not have the superabundance of iron and steel, or the means of producing it which we possess. Wren, most scientific of constructors, made the best possible use of the scanty supply at his disposal, when he encompassed the dome of St. Paul's with four tiers of chain bond, wisely inserted in the masonry. As a further precaution, a complete ring of bar iron,

FIG. 16.

riveted together in short segments, was sunk into the stone gallery behind the parapet, and to make doubly sure, run with lead, instead of being bedded with mortar. Unlike us, he did not have Portland cement in which to set his Portland stone; nor yet a catalogue of rolled sections at his elbow, from which to select the shape, size, and weight best suited to the particular work on which he happened to be engaged. What use he would have made of these, we are at liberty to infer from the skillful way in which he applied the meager resources at his command. Of one thing we may be certain; he would not have used wood,— not even oak of English growth, and of which the "wooden walls" were built, until retired in favor of armor plate,— in the framework of the outer dome. But with him, as with all his predecessors, the supply of iron was limited, its cost relatively high, and the size of the forgings no more than could be hammered into shape, or welded on an anvil. So far, however, as it was available, they did not hesitate to employ it in connection with both wood and stone, and had they possessed half our facilities for the production of iron and steel, they would certainly have turned the product to good account. Possessing these serviceable materials we must be at liberty to use them, in an age of electicism, of which it may be said, that sufficient for the day are the resources thereof. Like many other things in the affairs of life, the use of iron as an ally to terra-cotta becomes censurable, only when it is abused, by being applied in the wrong place, or in an injudicious manner, and (as often happens) when no extraneous support is required. On the other hand, the converse of all these furnishes an unanswerable vindication of the legitimate use of both materials.

The availability of these resources being granted, it is part of our self-imposed task to show in what way the best possible use may be made of them, under various conditions. Some of these conditions are unalterably fixed; and may as well be frankly accepted as such, without wasting words on theories no better than a spider's web, as to "what might have been." Others again are so variable as to be considered in the light of an unknown quantity, until they assume definite shape. These must be met; if not by existing methods, then by special devices; or by the readjustment of those with the practise of which we have become somewhat familiar. There are, however, other conditions, — and they by no means the least important — which are entirely of *our own making*. It is with these that we propose chiefly to deal. And, as it is but a new reading of an old axiom to say in this connection that "example is better than precept," we shall give "line upon line"; backed up in most cases by what some idealist has been good enough to term "the brutal fidelity of a photograph."

Beginning in each case with the more elementary problems of the class to which they belong, we shall in due time deal wlth others of a sufficiently complex character, most of which will be from work actually done. A simple portico having but little projection from face of building is shown in section at Fig. 15. The maximum distance between columns being about 9 ft., the necessary support is supplied by two 5 in. channels placed back to back, and bolted together at intervals of 4 ft., with just enough room to receive the ¾ in. hangers; which, passing between them, take the place of separators. The soffit blocks are made in lengths of 1 ft. 10 ins., with two hangers placed 3 ins. from the ends. The ¾ in. rod having been inserted in the hole, which passes longitudinally through each piece, the chambers are then filled with concrete before being set in position. A level staging should be erected in line with top surface of abacus, on which to rest the blocks. The ¼ in. rebate left in the ends to form a receptacle for the mortar, and each block being pressed against the preceding one, a sufficient body of mortar will be retained securely between the ends of the blocks, though the vertical joint need not appear more than three sixteenths of an inch on face of the work when pointed up. The two channels having an independent bearing on each capital, the hangers may all be adjusted to requisite tension by nut and washer until the whole architrave is in line. When a slightly wider soffit has to be suspended, that may be done by means of an I beam of sufficient weight, instead of the two channels. A plate of ⅜ by 4 in. iron, with a hole in each end, is laid across the upper flange; and from it two (or if necessary, four) hangers take hold of each block in the manner indicated in alternate section.

The blocks forming frieze are molded to fit on flanges, with just enough allowance for cement, and have a continuous chase made to clear the heads of nuts, etc. The vertical joints of the inner and outer courses should alternate, and the two thicknesses may then be cramped together on top bed. The platform is made in single blocks with paneled soffit, and bonded into wall as indicated in section. These blocks contain from 9 to 12 cu. ft., which, in some situations, are certainly much larger than it would be advisable to attempt. But in the present case, their *shape* is so suitable and the other requirements so convenient, that no special difficulty was experienced in turning them out free from cracks and fairly accurate in size. Scuppers are provided in parapet panels to

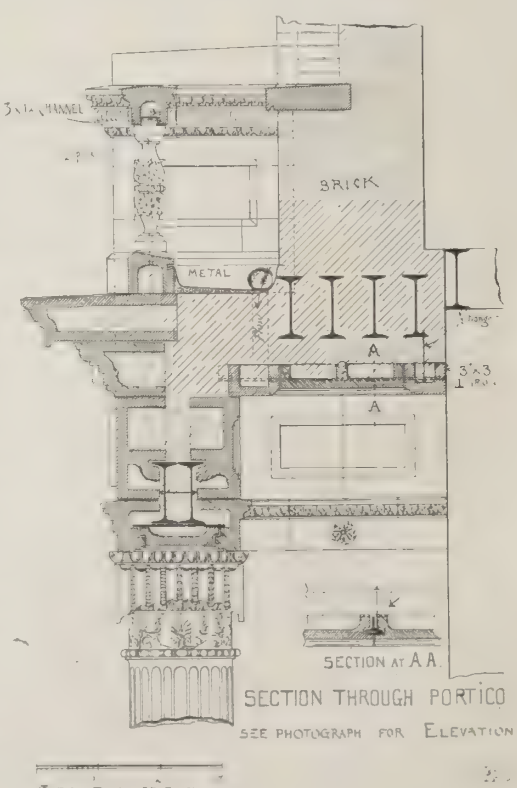


FIG. 17.

allow rain water to escape, and a raised fillet on each end of the block, prevents any of it entering the vertical joints. It will be seen from the photograph (Fig. 16) that the actual result obtained is quite presentable, and that the same principle of construction as shown in this simple example may be adopted in work of greater magnitude and importance.

In the portico shown at Fig. 17, where the span is wider, and the load to be carried much greater, a somewhat different arrangement has been made. A girder composed of two 12 in. I beams and

FIG. 18.

an 18 in. cover-plate is necessary in that case. The soffit being 2 ft. wide (which is equal to the size of column at its greatest diameter), it could not be made in single blocks with sufficient accuracy to give good alignment in the architrave on *both* faces. This member is made in three sections, two of them being molded to fit on the flanges of cover-plate, with the panel resting on rebates between them. The architrave and frieze are continued around vestibule, and the paneled ceiling is carried on the inverted tee sections inserted in joints at A.A. The space between the inner and outer blocks of frieze is backed up with brick, and the two thicknesses anchored together on top bed. Balusters are usually jointed in short sections for greater convenience of pressing. In this case they are made in two pieces with a ¾ in. hole in center for an iron rod, one end of which presses down into plinth, the other extending through channel, which has been holed to suit spacing of balusters. The ends of this channel are built into pedestals, and it but remains to set the coping to line on a good bed of cement, taking care that the vertical joints are all well filled and neatly pointed. The enclosed space behind balustrade is covered with metal, flashed into a continuous groove around plinth and graded to outlets with leader at each side of portico. So much for the anatomy of the subject; which, however needful, is usually forgotten after the components have been assembled. There are, of course, several ways in which an entablature of this kind could have been supported, and some of them will be embodied in subsequent examples. This one, however, was found to answer its intended purpose and was favorably spoken of by the men who set the work, whom, it would seem, did their share of it with more than ordinary intelligence. Among other evidences of care and forethought may be noted the slight camber over the opening; just sufficient to correct the optical illusion, which makes a perfectly straight architrave appear to sag. In Fig. 18 we see the skeleton clothed, and are better able to judge whether or no — in a materialistic sense at least — "the end justifies the means."

Fire-proofing Department.

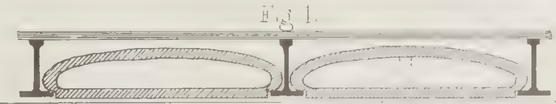
ORIGIN AND HISTORY OF HOLLOW TILE FIRE-PROOF FLOOR CONSTRUCTION.

BY PETER B. WIGHT.

IN preparing the following notes the writer feels the necessity of offering an apology in advance for the use of the first person singular, for there does not seem to be any possible way to avoid it if this history is to be complete. In the places where this has to be done the reader will kindly bear in mind that he has no financial interest now in the matters to be referred to.

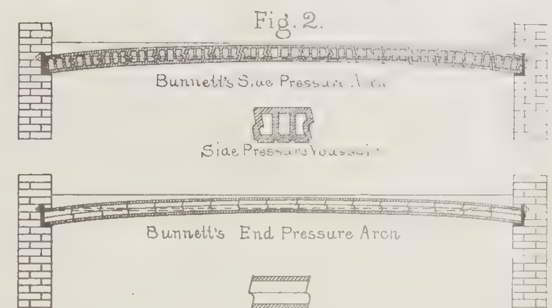
The use of brick arches for floor construction was coincident with the introduction of the manufacture of I beams into this country, and had preceded it to a certain extent; for, a few floors had been constructed before 1850 in which cast-iron I beams had been used, and in some of these the I beams had been strengthened by the insertion of a wrought-iron rod shrunk in a recess on the under side where the flanges of the I join the web. Rolled deck beams inverted had also been used for floors. In all these cases brick arches were used. I beams of the general section now employed, or double T beams, as they were sometimes called, were first rolled in France in 1853. Their introduction was generally followed in that country by the "Thausne System," which consisted of filling the space between with plaster béton reinforced by occasional iron bars. I beams were first rolled in this country by the Trenton Iron Works, in 1854, and were first used in the Cooper Institute in New York; though the beams of the first floor were made of two channels riveted together, and those of some of the upper floors were of inverted deck

Fig. 1.



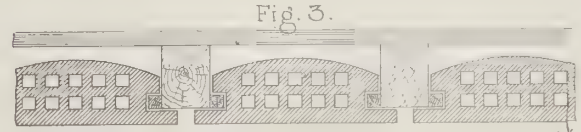
American Patent issued to F. A. Peterson April 3 1855.

Fig. 2.



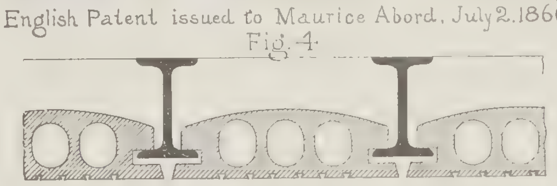
English Patent issued to Joseph Bunnett June 8. 1858.

Fig. 3.



English Patent issued to Maurice Abord, July 2. 1866.

Fig. 4.



American Patent issued to Maurice Abord Aug. 21. 1866

beams. The first building in America in which I beams were used throughout was the brownstone Court House in City Hall Park, New York.

It is a fact, however, that hollow burned clay tiles were used in

this country as soon as I beams were rolled, though their employment cannot be considered as having been anything more than experimental. They were invented for the Cooper Institute, and used in the first story only, by Frederick A. Peterson, the architect of the building, whose name, by the way, appears among the "Founders" of the American Institute of Architects in the last printed *Proceedings*. These, according to the best evidence obtainable, were the first hollow burned clay tiles for floor construction ever designed, made, and put into a building, and the invention and introduction can be fairly claimed as American. As proof of this assertion I will add that I am in possession of the records of two important lawsuits involving the authenticity of the invention of flat hollow arches and the fire-proofing of I beams, and that the records of all inventions and publications bearing on the subject were exhaustively searched by the parties in interest for evidence affecting their respective sides. The patent taken out by F. A. Peterson, April 3, 1855, anticipates all others, and while it would in these days likely be considered impracticable, it was put in use in this one building through the perseverance of the architect, and the determined pertinacity of Peter Cooper. When a schoolboy I remember seeing the work set. When involved in a lawsuit in which it was thought necessary by my attorneys to present evidence of what was then done, I found the building in process of alterations, and was enabled not only to make drawings of the construction on the spot, but to remove some of the tiles. I found that they were all made of a semi-fire-clay and molded by hand. The following section drawing is taken from the patent issued to Peterson, and shows exactly how the floors were built. (Fig. 1.)

The drawing shows inverted deck beams; but double 3 by 6 in. channels were used, so that they were 6 ins. wide top and bottom. They were set about 2 ft. 6 ins. from centers. The bottoms of the beams were covered with cement, flush with the bottoms of the tiles. The ceilings then received two coats of plaster.

Fig. 5

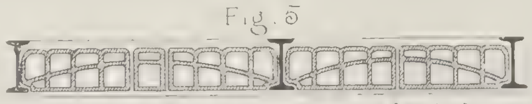
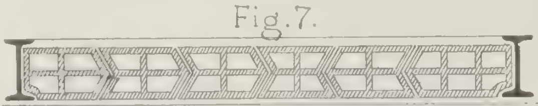


Illustration in Descriptive Pamphlet of E. Muller & Co France 1867.

Fig. 6.

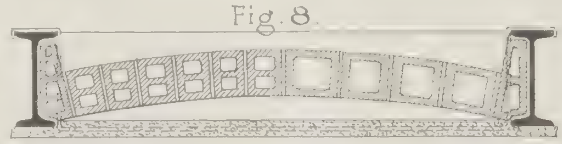
Another Form of Arch by Professor Muller, from the Gazette des Architectes. Paris. 1867.

Fig. 7.



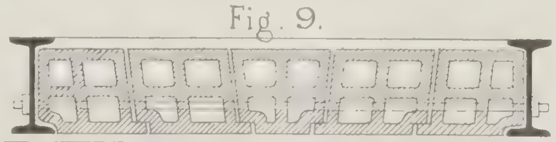
M. Verdier's flat Arch, from Illustration in the Gazette des Architectes. Paris. 1867.

Fig. 8.



From Leonce Reynaud's Traite d'Architecture Paris, 1867.

Fig. 9.



Vincent Garcin's French Patent. Oct. 11. 1867.

The above construction was never repeated, to my knowledge. The usual method for filling between I beams, thereafter used for many years, was with segment brick arches, and flat ceilings were obtained by furring off, in some cases with wood, and in others with iron, using corrugated iron lathing. There were some instances in which sheet iron, with very deep corrugations, and flat in form, was laid on the bottom flanges of the beams and covered with concrete. In these the ceilings were furred off for lath and plaster. I know of one instance where slabs of sandstone were set on the bottom flanges of the beams and carved with tracery patterns to form an ornamental ceiling pattern. In this the bottoms of the beams were covered with ornamental cast iron. In one building the space between beams was filled with heavy boiler plates riveted to the top, and a patent was taken out by Samuel P. Snead, of Louisville, the founder of the Snead family of iron workers, for filling between the beams with ornamental cast-iron plates. It was many years before corrugated iron arch plates were used.

Three years after the date of the Peterson patent, Joseph Bunnett, of Deptford, England, on June 8, 1858, took out a patent for constructing very wide span segmental arches of hollow tiles between wall plates of angle iron, connected by iron tie-rods. The Bunnett arch was shown by two sectional drawings, and in each the arch was of sufficient length to cover a moderate-sized room, and with very slight rise, so that the tie-rods were contained within the arches. One of these arches was on the side-pressure, and the other on the end-pressure plan. The tiles were described as being pressed out through dies, with hollow chambers and webs. Those for the side-pressure arches had peculiar notches on the sides, and were cut off square at the ends, while those for the end-pressure arches were of the same section, but cut off in the ends to the same section as the sides. The result was that the side-pressure arches could be set with broken joints, and the end-pressure arches so that each course could be notched into the adjoining course, thus avoiding a defect in all end-pressure arches that have lately been used so extensively. The key tile of the side-pressure arch was made with notches on both sides. In this patent we find the earliest claim for using independent voussoirs for hollow-tile arches, and the first for pressing them out through dies by machinery. It also establishes the early date of the invention of arches constructed on the end-pressure principle. The following illustration is reproduced from the drawings attached to Bunnett's patent. (Fig. 2.)

Bunnett was a well-known clay manufacturer, and brought his invention into use. I remember finding, with great surprise, a sample arch of this construction set up on a vacant lot in the rear of the temporary office of architect W. W. Boyington, at Chicago, in 1872, very shortly after the great Chicago fire. At that time several architects had temporary offices in the burned district, my own among them. But I have never heard of the Bunnett arch being used in Chicago, or elsewhere in this country. The sample was of about 12 ft. span, and with only a few inches rise, and was not more than 6 ins. thick. It must have been sent over from England in expectation that the lessons of the great fire would result in the erection of many fire-proof buildings. But this was not the case. There was no time to study up the subject. The most that was done at first was to greatly increase the thickness of brick walls between buildings, to which architects and owners then agreed, as a provision against the spread of fire, even before any special laws had been passed. As one of the results, the building laws of Chicago now require an average thickness for party walls in high buildings greater than those of any other large city. Another is seen in the fact that the fire records since that time show that fires in Chicago are almost invariably confined to the building in which they originate. The second great fire of 1874, which raged through frame buildings for several blocks, was stopped when it reached the new five-story brick party walls on Wabash Avenue.

Invention in this direction seems to have ceased for eight more years. The Americans were using brick floor arches, and in some cases corrugated iron; the English were using solid concrete arches, that invented by Dennett being a favorite, and the French used the plaster concrete filling, called the Thausne System. On July 2, 1866, Maurice Abord, of Buissonniers, France, took out an English patent for a solid-tile arch in one span with arched top and flat bottom, for use between wooden floor joists. He had probably previously patented it in France. But very shortly after, August 21, 1866, he took out a similar patent in the United States, in which he showed the combination of his arch brick with I beams. While his arch tile was similar in general form to that of Peterson, it differed from it in that the soffit was set much lower, and projections on the sides formed a covering or protection to the beam which he specifies as being useful in fire-proof work. This appears to be the first inven-

tion patented in which burned clay is used for the protection of the bottoms of both wooden and iron beams from fire simultaneously with the construction of flat plastered ceilings. Illustrations from but the English and American patents are here given. (Figs. 3 and 4.)

Following this invention there seems to have been a great revival of interest in the subject, though there is no evidence of Abord's invention having been put into practical use. The objection to it was the same that held against Peterson's. It was very difficult and expensive to make such large hollow tiles of clay, and not economical to set the beams close enough together to use tiles of a size within the practicable limits of manufactures of clay. But the interest in fire-proof floor constructions with hollow tiles found its expression in the French International Exposition of 1867 in many ways, and several inventions appeared which there is no record of having been patented. They are, however, described in many publications of the time. Emile Muller, professor of construction at the Central School of Arts and Manufactures, Paris, in 1867, made many inventions for floor and ceiling constructions with I beams and hollow tiles. Among these is one described and illustrated in the price-list of E. Muller & Co., called "Light hollow filling, termed plate band brick, for filling in of floors," of which I give a reproduction. (Fig. 5.)

It will be seen that he used in some cases two bricks, and in others three. In the latter the third brick acted as a key. In these there appears to be no protection for the bottom of the beams except by carrying the plaster over their surfaces. The circular shows many other kinds of hollow tiles for segment arches (in which they are arranged in voussoirs), partitions, and other purposes for which they are used to-day.

In the *Gazette des Architectes* for 1867 I find a description of some of the French exhibits of hollow tiles. Here is an illustration of another invention of Professor Muller, similar to the last described, the arches being in two pieces. (Fig. 6.)

Another interesting exhibit is thus described: "Mr. Verdier has exhibited a floor formed of hollow brick, fitting the one into the other; one of them forms the key, and those which touch the beams are of variable length, so that the joints may be broken on each row. Very little mortar suffices to unite together these bricks which are held together, so that if one takes care to bond them in setting, the soffit of the arch shows a concavity of two centimeters between the beams." (Fig. 7.)

It will be observed that this is a flat arch though built of symmetrical tiles, and is equally strong as against a weight or upward pressure. The utility of this is not apparent where the floors are only intended to carry loads on top.

In Leonce Reynaud's *Traite d'Architecture*, Paris, 1867, is a description of hollow-segment and flat-arch construction between I beams accompanied by two illustrations. The former shows the style of segment arch now in use. The latter is the first flat hollow-tile arch in voussoirs as now generally used of which there is any record, and was the invention of Vincent Garcin, who patented the same in France, Oct. 11, 1867. These two styles of beam filling arches are here shown. (Figs. 8 and 9.)

To Vincent Garcin, therefore, must be ascribed the invention of the practicable flat hollow-tile arch as now so extensively used in this country. It will be noticed that this arch still leaves the bottoms of the beams exposed, to be covered only with plastering. But it has another feature. There are projecting lugs on the bottoms of the voussoirs and corresponding recesses, as if to prevent each successive voussoir and the key from slipping down. This idea seems to have taken hold of many succeeding inventors, and several patents have been taken out in this country for similar devices, evidently without knowledge, on the part of patentees or examiners at the patent office, that they were anticipated by the Garcin patent. But the idea was not even new with Garcin, for it was anticipated by the Englishman Bunnett. The futility of all such changes from the simple form of voussoirs with straight joints was long since established.

(*To be continued.*)

Mortar and Concrete.

AMERICAN CEMENT.

BY URIAH CUMMINGS.

CHAPTER VII.

CEMENT TESTING.

(*Continuation of tests made by Prof. Cecil B. Smith.*)

PAPER II.

Frost Tests.

IN a previous paper, read before the society, the writer promised to place before its members the results of certain frost tests, which were being made at that time.

They are now given, in hope that they may be of some interest to those engineers who are contemplating the building of cement mortar masonry, or cement concrete in cold weather.

Method of procedure. — The briquettes were all made in the same manner, the 1 to 1 mixtures having 18 per cent. of water, and the 3 to 1 mixtures 15 per cent., being purposely greater than the amount used in ordinary laboratory tests, so as to get the mortar softer, and resembling more closely the condition in which masons use mortar in ordinary construction, as the effect of frost may be greater on soft mortars than on dry ones.

The briquettes were all rammed into the molds in 3 layers, and the briquettes to be subjected to frost tests were immediately put

FOUR MONTH TESTS.

BRIQUETTES MADE DURING MONTH OF NOVEMBER, 1894.

Date of Exposure.	No. of Brand. (See Paper I.)	Ordinary time of setting. Initial.	Ordinary time of setting. Full.	Mixture.	Temperature at time of mixing. Lab. air.	Temperature at time of mixing. Water.	Temperature at time of mixing. Materials.	Temp. of outside air.	Time elapsed from mixing to time of exposure.	Tensile Strength. Lab. Tests.	Tensile Strength. Exposed specimens.	Remarks concerning exposed specimens.
Nov. 14	1	6°00′	12°00′	1 to 1	59°	56°	59°	36½°	10′	321	236	All these were of natural cements. They were brought in and kept 2 or 3 hours before testing, and allowed to warm so as to drive out the frost, and insure a test not being made on a frozen specimen. There were no external signs of any effect produced by 4 months' exposure.
16	old sample 2	5°30′		1 to 1	64°	60°	64°	53°	7′	302	220	
2	2	45′	2°45′	1 to 1	65°	58°	60°	60°	10′	484	250	
1	15	1°00′	2°30′	1 to 1	65°	62°	64°	66°	10′	541	237	
				Averages	63°	59°	62°	51°	9¼′	412	236	
Nov. 5	3	5°00′	20°00′	1 to 1	68°	65°	65°	37°	12′	143	147	All these were of Portland cement. They were, when necessary, brought into the laboratory and kept there for 2 or 3 hours before being tested, so as to insure that no tests were made on frozen briquettes. No signs of the effect of frost were visible on any of the specimens.
26	4	37′	3°10′	3 to 1	64°	58°	57°	29°	7′	236	200	
27	5	1°00′	5°00′	3 to 1	61°	62°	56°	36°	9′	237	183	
28	6a	2°00′	6°30′	3 to 1	68°	64°	63°	28°	8′	222	128	
6	8	3°20′	6°30′	3 to 1	63°	59°	60°	42°	9′	172	114	
9	9	13′	2°00′	3 to 1	64°	57°	61°	32°	11′	194	182	
13	10	25′	50′	3 to 1	62°	57°	57°	35°	7′	174	176	
19	11	30′	1°0′	3 to 1	60°	55°	57°	34°	8′	153	141	
21	12	25′	3°00′	3 to 1	60°	52°	58°	39°	9′	119	102	
20	14	20′	2°30′	3 to 1	61°	54°	58°	26°	9′	131	125	
22	19	2°40′	7°40′	3 to 1	58°	54°	56°	37°	7′	253	387	
				Averages	62½°	58°	61°	34°	8⅔′	185	171	

outside on a window-sill. In a few hours, after the briquettes were frozen hard, they were removed from the molds, and left exposed on the window-sills for two, three, or four months, care being taken to keep the snow swept off so as to allow the frost to have its full effect.

The tables, given, speak for themselves, and probably each engineer will draw special conclusions of his own; the writer will only mention a few points that seem obvious to him.

I. FOUR MONTHS TESTS.

It would appear, from these tests, that it is quite safe to build masonry work in November, in Montreal climate, when the materials are mixed and exposed to the air at about the freezing point. The proportion which the strength of the frost tests bears to the submerged ones is about that which would be obtained under the most favorable circumstances. The briquettes were all firm, smooth, and hard on the surface, and although subjected to 4 months of severe frost in an exposed position, they did not seem to have been at all damaged.

II. THREE MONTHS TESTS.

These were all made in December, and the coldest days were purposely selected. Yet the only briquettes which were blown in pieces were those made from two very inert, slow-setting, poor Canadian natural cements. The two other natural cements (one Canadian, the other Belgian) were quicker setting, and stood the test well. With the Portland cements, the diminution in strength is more apparent than real, the proportion of 90 to 164, which is the average of 11 brands, is really between briquettes ¾ to ⅞ in. square, and briquettes 1 in. square, the frost specimens being weathered off.

It is reasonable, however, that a briquette 1 in. square, exposed on 3 sides to the direct action of the frost, is rather more severely tested than mortar would be if placed in a wall, even the bottoms of the briquettes resting freely on the stone window-sills were largely uninjured, and the centers of all the briquettes appeared uninjured. As a result of these experiments, the writer would feel perfectly safe in laying cement mortar in December, with Portland or active natural cements, in weather 10 to 15 degs. above zero, and in the most exposed situations, expecting in the spring, to find ¼ to ½ ins. disintegrated at exposed joints, and needing re-pointing, or better still, the pointing could be left till spring, and done once for all.

III. TWO MONTHS TESTS.

These tests were much more severe in their nature, the sand and cement were exposed for hours in the open air, in small quantities, until they were absolutely down to the temperature of the outer air, and in the cold water and salt water series the water was also exposd, until it was, in three cases, actually below the freezing point, being in a slushy condition.

These materials were put together in the laboratory, as rapidly as possible, and exposed again at once, the usual interval being about 6 minutes, and the actual temperature of the mortar just before exposure having reached about 33 or 34 degs. F., while in the hot water tests the mixture rose, on an average, to 58 or 60 degs., just before exposure, which was just about laboratory temperature.

The experiments are hardly extensive enough to be fully conclusive, being made only on 7 brands of cement, but they point clearly to the advantage of the use of salt. Those briquettes made with salt showed good strength and little injury; although made with materials, at low temperatures exposed in severe cold, they seemed to be chiefly affected only on the surface.

THREE MONTH TESTS.

BRIQUETTES MADE DURING THE MONTH OF DECEMBER, 1894.

Date of Exposure	No. of Brand. (See Paper I.)	Ordinary time of setting. Initial.	Final.	Mixture.	Temperature at time of mixing. Lab. air.	Water.	Materials.	Temp. of outside air.	Time elapsed from mixing to time of exposure.	Tensile Strength. Lab. Test.	Exposed specimens.	REMARKS CONCERNING EXPOSED SPECIMENS.
Dec. 26	1	6°00′	12°00′	1 to 1	62°	60°	58°	+ 7°	5′	247	0	Briquettes frozen long before set could take place, all blown to pieces by frost.
24	(old) 2	5°30′		1 to 1	60°	52°	53°	+10½°	7′	198	0	ditto
1	2	45′	2°45′	1 to 1	65°	60°	60°	+19½°	8′	190	233	Seemingly quite sound, but broke irregularly as to loads and position of fractures.
1	15	1°00′	2°30′	1 to 1	61°	56°	56°	+16°	7½′	484	311	Practically sound, some slight cracks on the surface.
Average of No. 2 and No. 15					63°	58°	58°	+18°	7¾′	337	272	
Dec. 3	3	5°00′	20°00′	3 to 1	60°	60°	56°	+17°	7′	108	101	About 1-16″ on the surface, disintegrated, the remainder quite sound.
31	4	37′	3°10′	3 to 1	60°	56°	56°	+19°	6′	204	85	ditto
31	5	1°00′	5°00′	3 to 1	48°	45°	46°	+14½°	6′	218	111	ditto
31	6a	2°00′	6°30′	3 to 1	52°	48°	49°	+ 8½°	6½′	247	47	Three of these disintegrated for 1-16″ on outside, the other two injured to the very center, average of three being (72).
8	8	3°20′	6°30′	3 to 1	69°	63°	63°	+21°	6½′	191	163	Seemed perfectly sound and solid.
10	9	13′	2°00′	3 to 1	68°	64°	64°	+14°	8′	151	113	These during a warm spell of three days remained quite soft, not setting at all; when tested, they showed a slight weathering on the top surface.
18	10	25′	50′	3 to 1	57°	53°	53°	+18½°	7½′	132	154	Seemed perfectly sound and solid.
27	11	30′	1°00′	3 to 1	70°	65°	65°	+ 7°	7′	107	59	Disintegrated for ⅛″ on top and sides, remainder solid looking.
28	12	25′	3°00′	3 to 1	61°	55°	59°	+ 9°	6′	89	23	Disintegrated for ¼″ on top and sides, remainder solid looking.
31	14	20′	2°30′	3 to 1	50°	50°	54°	− 7°	7′	131	49	ditto
29	19	2°40′	7°40′	3 to 1	65°	61°	61°	− 6°	6′	223	87	Only 1 briquette was disintegrated on the surface, but all were weak and brittle, crumbling if rubbed with the fingers.
Averages					60°	53	54°	+10½°	6⅔′	164	90	

TWO MONTH TESTS.

(With cold water.)

BRIQUETTES MADE DURING THE MONTH OF JANUARY, 1895.

Date of Exposure.	No. of Brand. (See Paper I.)	Ordinary time of setting. Initial.	Full.	Mixture.	Temperature at time of mixing. Lab. air.	Water.	Materials.	Temp. of mixture just before exposure.	Temp. of outside air.	Time elapsed from mixing to time of exposure.	Tensile Strength. Lab. Tests.	Exposed specimens.	REMARKS CONCERNING EXPOSED SPECIMENS.
Jan. 14	2	45′	2°45′	1 to 1	61°	32°	+19°	40°	+18°	6′	295	21	Practically all blown to pieces, the solid core of two briquettes giving 105 lbs.= 21 lbs. average.
5	15	1°00′	2°30′	1 to 1	57°	36°	+26°	38°	− 3°	6′	330	87	All the exterior blown to pieces, interior solid.
			Averages		59°	34°	+22½°	39°	+ 7½°	6′	312	54	
Jan. 21	3	5°00′	20°00′	3 to 1	63°	32°	+14°	34°	+13°	6½′	86	0	All soft and crumbling. No strength at all.
24	8	3°20′	6°30′	3 to 1	57°	32°	+ 5°	36°	+ 5°	9′	214	5	Cement frozen when mixed 6′. mixed by hand, a very severe test; briquettes appeared firm on surface, but crumbled when touched.
29	9	13′	2°00′	3 to 1	60°	32°	+20°	37°	+18°	6½′	133	92	Disintegrated on top for 1-16″; remainder solid.
Feb. 5	10	25′	50′	3 to 1	55°	34°	−11°	30°	−11°	6′	145	39	This mortar frozen when mixed, mixed by hand on table, a very severe test, briquettes appeared firm on surface, but weakened all through.
			Averages		59°	32½°	+ 7°	34°	+ 6°	7′	144	34	
	Average of Nos. 3, 8, and 9				60°	32°	+13°	36°	+12°	7′	144	32	

TWO MONTH TESTS.

(With hot water.)

BRIQUETTES MADE DURING THE MONTH OF JANUARY, 1895.

Date of Exposure.	No. of Brand. (See Paper I.)	Ordinary time of setting. Initial.	Ordinary time of setting. Final.	Mixture.	Temperature at time of mixing. Lab. air.	Temperature at time of mixing. Water.	Temperature at time of mixing. Materials.	Temp. of mixt're just before exposure.	Temp. of outside air.	Time elapsed from mixing to time of exposure.	Tensile Strength. Lab. tests.	Tensile Strength. Exposed specimens.	REMARKS ON EXPOSED SPECIMENS.
Jan. 18	2	45′	2°45′	1 to 1	64°	125°	35°	68°	+11°	6′	428	109	Badly blown on exterior for ⅛″, but interior still solid.
5	15	1°00′	2°30′	1 to 1	57°	126°	30°	65°	+ 3°	6′	250	23	Top surface blown off for ¼″, interior solid looking.
			Averages		60½°	125½°	32½°	66½°	÷ 7°	6′	339	66	
Jan. 21	3	5°00′	20°0′	3 to 1	63°	125°	18°	61°	+15°	6′	85	0	All soft and crumbling, no consistency at all.
23	8	3°20′	6°30′	3 to 1	64°	110°	20°	59°	+20°	6½′	99	47	Set very slowly in laboratory, those exposed were neither frozen nor set after 4 hours.
30	9	13′	2°00′	3 to 1	63°	119°	18°	59°	+18°	5½′	109	88	Disintegrated for about ⅛″ on top, remainder solid.
Feb. 5	10	25′	50′	3 to 1	55°	115°	—11°	54°	—11°	7′	132	21	Slightly disintegrated on top, and weakened all through.
			Averages		61°	117°	+11°	58°	+10½°	6′	106	39	
	Average of Nos. 3, 8, and 9				64°	118°	+19°	60°	+18°	6′	98	45	

TWO MONTH TESTS.

(With 2 per cent. of salt in the water.)

BRIQUETTES MADE DURING THE MONTH OF JANUARY, 1895.

Date of Exposure.	No. of Brand. (See Paper I.)	Ordinary time of setting. Initial.	Ordinary time of setting. Full.	Mixture.	Temperature at time of mixing. Lab. air.	Temperature at time of mixing. Water.	Temperature at time of mixing. Materials.	Temp. of mixture just before exposure.	Temp. of outside air.	Time elapsed from mixing to time of exposure.	Tensile Strength. Lab. Test.	Tensile Strength. Exposed specimens.	REMARKS ON EXPOSED SPECIMENS.
Jan. 18	2	45′	2′45″	1 to 1	64°	32°	22°	41°	11°	6′	320	73	Blown on surface for about ⅛″, interior solid.
9	15	1°00′	2°30′	1 to 1	58°	40°	9°	42°	9°	6′	280	143	Slightly blown on bottom, other fine cracks on top, otherwise solid.
			Averages		61	36°	15½	41½°	+10°	6′	300	108	
Jan. 21	3	5°00′	20°00′	3 to 1	65°	29°	25°	39°	25°	6′	101	39	Exterior worn with loose sand, but interior hard and firm, water was slushy at time of mixing.
28	8	3°20′	6°30′	3 to 1	56°	30°	13°	30°	12°	6½′	183	224	In perfect condition, water was slushy at time of mixing.
31	9	13′	2°00′	3 to 1	57°	30°	17°	30°	19°	6′	105	92	One briquette badly affected, and others quite sound.
	Average of (3)				59°	30°	18°	33°	17°	6′	118	130	No. 10 is not tested.

Note.— Each test recorded in this table is the average of 5 briquettes, all briquettes rammed moderately, in 3 layers, with an iron hammer having ½″ square end, and weighing about ½ lb.

On the other hand, the use of hot water does not seem to be of any advantage, particularly in Portland cements; a reason advanced by one writer for this fact was, that the bringing together of materials in a mortar, at widely divergent temperatures, exerted a prejudicial effect on the cement, hindering proper crystallization, and that the use of materials, at, as nearly as possible, the same temperatures would produce more rapid and stronger action. The effect of hot water on natural cements is not so disappointing, but does not show much increase over the strength of similar specimens made with cold water.

The general result of these experiments, to the writer's mind, points to the idea that in any weather, in winter, not extremely cold, say not lower than + 15 degs. F., masonry work can be laid with cold sand, cold cement, and cold water, provided the natural time of set of the cement is not more than 5 or 6 hours, and that by the addition of about 2 or 3 per cent. of salt to the water, the same work may be done in weather down as low as zero, which is as cold as men will work. The disintegration will not extend probably deeper than ¼ to ½ ins. — the remainder of the mass being quite sound.

By what process cement sets, after it has, in a few minutes, been frozen solid, and remains frozen for months, the writer will leave to others to explain, but set it certainly does, without ever having been thawed out.

THE ENGLISH METHOD OF BUILDING CEMENT SIDEWALKS.

EXCAVATE the ground to a depth of about 5 ins. below the finished level, and upon this lay about 1 in. thickness of cinder or gravel; upon this lay a layer of clean hard stone or other suitable material broken so as to pass through a 3 in. ring, well watered and rolled, filling up inequalities and leaving the surface about 2 ins. below the level of the footway (sidewalk). Divide into bays (sections) about 6 ft. in width with battens of soft wood, and complete each alternate bay by laying upon the stone foundation carefully prepared concrete composed of one part Portland cement, two parts coarse, clean gravel, or other suitable procurable material, passed through a 1 in. screen, and two parts clean, sharp sand, which must be well beaten or rolled into place; and before it is set a finishing coat 1 in. in thickness of a finer and richer concrete to be added and brought up to the finished surface of the footway, and well troweled and smoothed into place. This finishing coat may be composed of one part Portland cement to two parts granite chippings, three parts gravel or other suitable material which will pass through a ¼ in. sieve. As the work is finished the battens may be removed and the joints filled with fine sand. — *Carriage and Footway Construction.*

COLOR OF NATURAL CEMENT.

THE color of the manufactured cement, being due principally to the presence of a small quantity of oxide of iron and sometimes of manganese, or to the carbonates of these oxides, which for all practical purposes are conceded to be a passive ingredient in hydraulic mortar, should be a matter of indifference to consumers. In fact, the presence of a large proportion of the coloring principle, like that of any other inert substance, might be expected to have a tendency to deteriorate the quality of the mortar by diminishing the cohesive strength of the cementing substance, and, therefore, if taken into consideration at all, ought at least to direct suspicion to the darker varieties. — *Gen. Q. A. Gilmore.*

The Masons' Department.

THE ARCHITECT AND CONTRACTOR.

BY THOMAS A. FOX.

(*Continued.*)

FOREMEN.

THE one thing above all others which enables an individual, firm, or corporation to carry on an extensive building business is the ability to select competent and able foremen; and with the increasing complications involved in the construction of a large modern building, and the speed with which the work must be done, the duties and responsibilities which devolve on a foreman have materially increased. In truth, he must have practically all the qualities which go to make a successful master builder, differing only from his employer from the fact that he has no capital involved. When one considers the amount of time the average master builder must spend attending to the strictly financial side of his business in estimating travel and other details, it can readily be seen that the actual carrying out of a piece of work must necessarily be entrusted to a subordinate, and that upon his ability will depend to a great extent the success or failure of the undertaking.

Of the qualifications which go to make a competent foreman, the most important is an accurate and complete knowledge not only of his own particular trade, but of all others which come in connection with it; he must also be a thorough mechanic, for if he is unable to do work in the right and economical way himself, it is hardly possible that he will be able to show others how to do it.

After the mechanical skill as a requisite for a competent foreman should be placed foresight, which, although at first thought may seem to be a matter of minor importance, is, nevertheless, an essential quality. In order to have work which is done in a hurry (and very little, unfortunately, is now done in any other way) proceed smoothly, the foreman must be constantly planning ahead. He must have the method by which the work is to be carried on clearly in mind; he must see that the proper materials and sufficient in quantity are at hand when needed; and by no means least important, he must see that he has proper drawings from which to lay out the work in advance. While it must be acknowledged that many delays are caused by the lack of drawings, it must at the same time be admitted that if some one makes timely and reasonable requests of the architects the necessary drawings can be had, and the foreman is the man who should issue the reminders which are always necessary to keep such people up to time. A foreman who combines the two essential qualities of foresight and care will save his employer from much expense, and the architect from many embarrassing positions, for if the plain truth be told, the architect practically never pays for mistakes; the owner sometimes pays for them, while the contractor usually pays for them.

The first thing a foreman should do on receiving a roll of drawings is to look them over carefully to see if there are any practical difficulties which stand in the way of executing the work as proposed. He should also take the precaution to check the various lines of figures and make sure there are no discrepancies. In connection with this work the specifications should be read. If such a course is pursued, it enables the foreman to start the work with a clear idea of what is expected. In going over the drawings, a memorandum should be made of any discrepancies, omissions, or matters about which information is desired, and on the first opportunity which offers these matters should be talked over with the architect or his representative, when generally most of the questions which have arisen can be easily adjusted and explained. It is important, however, for the foreman to keep in mind the fact that it is out of his province, unless a special arrangement has been made, to make any changes which involve extras or allowances without first reporting the matter to his employer.

It may be the custom of some contractors to require all such transactions as have just been described to be done by the master builder in person; but as a rule, matters of mere detail, with the exceptions noted, can be settled in a perfectly satisfactory manner on the work. There is a disposition on the part of some architects and superintendents to ignore suggestions which are advanced by foremen, which, it is needless to say, is most short-sighted policy, but unfortunately practised to such an extent that many foremen, when asked why they did not call attention to some point in season to avoid trouble, reply that experience has taught them that the architect did not care to receive suggestions from their direction.

It is policy for the architect or his representative who superintends the actual construction of a building to say to the foreman at the beginning of a piece of work that there are two important things for him to remember; first, never to deviate from the plans and specifications without express permission; and secondly, if there is any point which is not fully understood or clearly shown, or if any work is shown or called for which he does not consider proper, he should invariably call attenion to the fact in time to have the matter remedied before any expense is incurred or harm done. If these simple suggestions are followed and the foreman understands that he is to work with the architect and not at cross purposes with him, many of the minor complications which ordinarily arise in building transactions will be avoided. Method and neatness are two qualities which should be cultivated by a foreman, for there is nothing which makes a better impression on both the owner and architect than to find that their work is being done under a well-defined system, and that the premises are always kept clean and free from an accumulation of rubbish. This also helps the contractor, for it is always possible under such conditions to advance the work rapidly, and with the least possible disorder and confusion.

It is particularly desirable for journeymen who wish to become foremen, and foremen themselves who have not had much experience, to make a special study of the trades other than their own which come in connection with their individual work, and it is excellent practise for such persons to take a course in draughting, which will enable them to thoroughly understand the drawings from which they are to lay out and execute their work. Such training was formerly given to a limited extent under the apprentice system, but since that has been abolished the learner is left to pick up the necessary information as best he can. With the development of night schools in the cities, however, there are ample opportunities for getting an elementary education in such matters, and it only needs the disposition to learn and some one (who can always be found) to direct intelligently the efforts of a beginner to enable a man to perfect himself in the theoretical matters which pertain to his trade, while at the same time he can be earning his living and gaining practical experience on the actual work.

LEGAL POINTERS.

A WORKMAN on a building, who fell and was injured by reason of stepping upon a joist which had just been sawed nearly through by another workman who had momentarily left it, cannot recover from his employer for such injury, on the ground that he should have been notified of the danger. — *Supreme Court, Massachusetts.*

AN architect who prepares plans for a building, and also superintends its construction, is entitled to a mechanic's lien for his entire services, but the preparation of plans alone, not supplemented with superintendence, does not give him a lien. It is the part the architect takes during the construction that draws his services within the lien law. And where only a portion of the work has been done, and the construction indefinitely suspended, the argument that the plans may be used eventually in the completion of the building does not assist the architect, for he never had a lien for his plans. — *Supreme Court, New York.*

Recent Brick and Terra-Cotta Work in American Cities, and Manufacturers' Department.

NEW YORK.— The most important event of late has been the finishing of the preparation of the charter for Greater New York, its unanimous acceptance by the commission, and its presentation to the legislature, the result of which we are all anxiously awaiting, as it is sure to have an important effect in many ways on the future of the architectural and building interests of the great metropolis. Probably as soon as the matter of government is decided the question of a new city hall will be again agitated, for the need has become an absolute necessity. We trust that the competition will be as well conducted as the late unpleasant one *promised* to be.

Greater interest was taken this year in the annual exhibition of the Architectural League than ever before, not only among members of the profession, but by the public at large. The lack of ability on the part of ordinarily intelligent persons to intelligently criticize a work of architecture has been especially noticeable for years past. This condition of things can be, and in fact has been, materially improved by the admirable exhibitions given by the Architectural League in New York, and by kindred societies in other cities. The exhibition is particularly fine this year, and gives a very good idea of the amount of work in hand for '97, which is encouraging. The prospects are good; an unusual amount of large work has been announced during the past month. One item of interest, and we must say regret, to architects is the contemporaneous demolition of the two finest specimens of Egyptian architecture in this country, — the old Tombs Prison and the Bryant Park Reservoir. The old historic prison will give way to a new and complete building 186 ft. long, 45 ft. wide, and 123 ft. in height. It will have a capacity for eight hundred prisoners, and will cost $700,000. Withers & Dickson are the architects.

Bryant Park will be cleared of the reservoir and all existing buildings, and the entire block bounded by Fifth and Sixth Avenues

TERRA-COTTA CAP, POPE BUILDING, BOSTON.
Peabody & Stearns, Architects.
Made by Perth Amboy Terra-Cotta Company, Waldo Bros., Boston Agents.

and 41st and 42d Streets will be devoted to the use of a great public library to be erected by the city. It will be the home of the New York Public Library, and the Astor, Lenox, and Tilden Libraries. The city is to issue $2,500,000 in 4 per cent. gold bonds for the purpose.

The Grand Central Station is to be altered and improved at a cost of $500,000. Bradford L. Gilbert is the architect. Several stories will be added for offices, and the towers materially altered.

NEW POPE BUILDING, BOSTON, MASS.
Peabody & Stearns, Architects.
Gray terra-cotta furnished by Waldo Bros., New England Agents for Perth Amboy Terra-Cotta Company.

The new waiting room will be one of the largest in the world. It will be 200 ft. long by 100 ft. wide, and will front on 42d Street.

The Academy of Design has finally decided on a site for its new building. They have bought the entire east block front in Amsterdam Avenue, between 109th and 110th Streets. The plot has a frontage of 171 ft., and in each of the side streets 200 ft. The site is opposite that on which the Cathedral of St. John the Divine is to be erected, and is near the handsome new buildings of St. Luke's Hospital and Columbia University. A competition will probably be held, and we trust will result in a building which will be a credit to that part of the city, which promises to be most attractive architecturally.

Many new office buildings will be begun this spring, and all very close together, in the neighborhood of Wall Street. Among them are the Empire Building, by Kimball & Thompson; Exchange Court, Clinton & Russell; Washington Life Insurance Company, C. L. W. Eidlitz; Singer Machine Company, Ernest Flagg; office building for the Crocker Estate, by C. C. Haight; and the American Realty Company, W. B. Tuthill. A new custom house is contemplated, the committee still being undecided as to a choice between the Bowling Green site and the present site on Wall Street. A new hall of records is also being considered.

PHILADELPHIA.— In building circles there certainly is seen some substantial improvement at the present time over the condition of a few months ago, and there is on all sides the usual preparation for a brisk season; whether the work expected will materialize or not will remain to be seen, but there is expressed by some of the most extensive builders and operators the opinion that all signs must fail if there will not be a prosperous season. The demand for modern business buildings in the heart of the city is as strong to-day as it ever was, and it is probable that some of the projects mentioned last month will be carried to completion. The one for the large business and office building on the southwest corner of Broad and Chestnut Streets is being pushed forward with more than usual energy, and the present status in that case is that the adjoining property, No. 1408 Chestnut Street, now occupied by the Citizens' Trust Company, has been purchased by Messrs. Widener & Elkins, and will be added to the corner plot; the tenants, it is understood, are to vacate on or before the first of April next. The property as a whole will be offered to the Land Title & Trust Company at its next meeting, on March 22, and it is this company which proposes to put up the extensive building. A competition between several invited architects was held some few weeks ago by Messrs. Widener & Elkins, but up to the present time no statement as to the selection of an architect has been given.

HORTICULTURAL HALL, PHILADELPHIA.
Frank Miles Day & Bro., Architects.
Architectural terra-cotta made by Conkling, Armstrong Terra-Cotta Company.

Considerable advance has also been made in the restoration of the old State House at 5th and Chestnut Streets. It is proposed to restore the entire group of buildings, as far as possible, to their original condition. The interior has been practically finished, and the buildings have been formally turned over and accepted by the city; the lower portion of the main and the two wing buildings will now be restored, and the arcades which originally connected the buildings will be reproduced. Estimates for the work are now being asked by Architect T. Mellin Rogers, who has had charge of the work since its commencement.

Bids are now being asked for an eight-story "housekeeping apartment" building, which is contemplated on the northeast corner of 13th and Budd Streets; this will be one of the most complete buildings of its kind, and the conveniences are first class in every respect. The entire building will be strictly fire-proof, Fawcett floors being specified, and the walls of brick, stone, and terra-cotta. There is an elevator in the entrance hall, and a lift in the rear of the building, extending from the kitchens into the basement, where the janitor's apartments and the compartments of each of the tenants for coal, wood, etc., are located. Each apartment consists of a parlor, library, dining-room, two bedchambers, kitchen, servant's room, pantry, two storerooms, linen closets, etc., besides a liberal amount of hall space, and an arrangement with the front and rear vestibules which completely isolates each apartment from the entrance as well as from the adjoining one; there are two apartments on each story. The architects are Wilson Brothers & Co., Drexel Building.

Edward A. Cameron, of St. Louis, has been appointed, after examination under the Civil Service rules, to the position of superintendent of construction of the Philadelphia Mint; his name, it is understood, was at the head of the list of applicants, and he has been highly recommended for the position by leading architects of Chicago and Boston. The contracts for the basement and area walls will be let within two months, and during the summer the contracts for the entire superstructure, including the marble, brickwork,

TERRA-COTTA MEDALLION, HORTICULTURAL HALL, PHILADELPHIA.
Made by Conkling, Armstrong Terra-Cotta Company.

and structural steel, will be placed. The intention of Architect Aiken is to carry on the work without interruption to its completion.

CHICAGO.— A matter of considerable interest to architects has been the exhibition of architectural work from the American Academy at Rome, which Mr. Charles McKim is so wisely sending

TERRA-COTTA DETAILS, HORTICULTURAL HALL, PHILADELPHIA.
Made by Conkling, Armstrong Terra-Cotta Company.

on a tour from city to city. Mr. McKim is certainly entitled to the gratitude of the profession, on which this exhibition will exercise a beneficial influence, for his personal trouble and expense in thus exhibiting the scholarship work of prize winners. Mr. D. H. Burnham generously defrayed the expense of bringing the collection to Chicago. Three of the twelve men whose works make up the large exhibit are associated with Illinois institutions. S. G. Temple is an instructor in the Illinois State University, and Messrs. MacNeil and Fellows are both instructors in the Chicago Art Institute.

A matter of concern to Illinois architects just now is a bill before the legislature which, if it passes, will institute in this State examinations and license fees to regulate the practise of architecture.

Building news continues to be depressing. The number of permits taken out is increasing with the season, but they cover, for the most part, a cheaper class of buildings.

One Chicago-Philadelphia item is that D. H. Burnham & Co. have on hand a fourteen-story building, which is to be erected in the Quaker City.

Henry Ives Cobb has a large " out-of-town " building, a savings bank at Albany, N. Y.

The underground Van Buren Street suburban station of the Illinois Central Railroad is now almost completed, and displays a very interesting variety of " burned earth " products. There are walls, floors, beams, arches, and columns covered with rough surface terra-cotta, hollow tile, variously colored glazed terra-cotta, enameled brick, and ornamental tiles. This list of finished work is varied with a considerable use of ornamental iron, marble, plaster, glass, and stone.

TRADE LITERATURE.

THE TIFFANY ENAMELED BRICK COMPANY, Chicago, have condensed much valuable information into another attractive little pamphlet, which treats in an interesting and instructive manner the uses and purposes of enameled brick. This book should be at the right hand of every one who contempletes employing this material.

TERRA-COTTA DETAIL, STEWART BUILDING, CHICAGO.
D. H. Burnham & Co., Architects.
Made by Northwestern Terra-Cotta Company.

WE have received a very attractive pamphlet issued by James A. Davis & Co., sole New England agents of the Alpha Portland Cement. It contains a number of illustrations of buildings, dams, and bridges in the construction of which Alpha Portland Cement was used exclusively; also a number of letters from prominent authorities indorsing the superior merits of this cement.

Copies of this book will be found very interesting, and may be had by applying to James A. Davis & Co., 92 State Street, Boston, Mass.

WE have received the recently published illustrated catalogue of fire-proof building material as manufactured by Henry Maurer & Son of New York. The fire-proofing products of this house are so well

STEVENSON BUILDING, INDIANAPOLIS, IND.
Henry Ives Cobb, Architect.
Built of gray brick and terra-cotta. Brick furnished by the Columbus Brick and Terra-Cotta Company and the terra-cotta by the American Terra-Cotta & Ceramic Company.

known, and have so strong a hold on the good-will of the building community, as to require very little comment on our part. There are one or two features introduced in the catalogue which are novel and interesting. One of these is the 2-in. Phœnix fire-proof hollow tile partition, which is made of hollow burnt clay or porous terra-cotta tiles, set on edge, with a long strip of band iron imbedded in cement or mortar between the courses, giving to the 2-in. partition the same tensile strength as a wall 4 or 6 ins. thick. The catalogue also illustrates the forms of hollow brick which are made to be used as bottle racks, which is somewhat of a novelty in its line. There is also illustrated the Eureka system of hollow tile floor construction, which comprises three tiles, two skew-backs which fit the beams, and one center or key tile, forming a flat ceiling of floor requiring no centering during the erection, which can be put in rapidly with or without the use of cement, as the tiles cannot work out or get

loose in any manner. In addition there are the standard shapes manufactured by this company, together with reports of tests, etc., and many very valuable suggestions as to fire-proofing methods.

THE pamphlet recently issued by Fredenburg & Lounsbury, Metropolitan Building, New York, sole agents in New York and New

TERRA-COTTA CAP, Y. M. C. A. BUILDING, NEW YORK CITY.
Parish & Schraeder, Architects.
Made by Excelsior Terra-Cotta Company.

England for the Hydraulic Press Brick Companies, contains a concise and splendidly arranged description of the various structures erected of the Hydraulic Press Brick during the years 1895 and 1896, together with mention of color and shape of brick, character of trimming of the buildings, and the names of the architects and builders.

The book has been carefully compiled with a view to making it particularly serviceable to an architect desiring to adopt a shade of brick different from those he is accustomed to employ. By consulting its contents, he can ascertain the location and general character of the buildings wherein a particular brick in which he is interested has been used, and he is then in a position, if he so desires, to make a systematic inspection of the work in question, and see the various shades in actual use, in buildings of varied designs, and note the effect of same with the several combinations of stone, terra-cotta, etc.

We can commend Messrs. Fredenburg & Lounsbury on the general good style and character of their contribution to trade literature, and are glad to recommend it as being of real interest to those engaged in the building profession.

OF INTEREST.

WALDO BROS. have closed a contract with Hootons & Hemmenway, of Providence, for furnishing the terra-cotta for the new building for the William F. Low estate, Westminster Street, Providence.

THE Celadon roofing tiles have been specified for the Municipal Building, Yonkers, N. Y., E. A. Forsythe, architect. Also for the residence for Phillip Kleeburg, Esq., New York City, H. P. Gilbert, architect.

THE UNION AKRON CEMENT COMPANY, of Buffalo, are furnishing their Akron Star Brand of cement for the new building of the Brooks Locomotive Works, at Philadelphia, and also for the Willard State Hospital, at Willard, N. Y.

WALDO BROS. will furnish the terra-cotta roof tiles for the Newton Bank Building, Newton, Mass. They will be a very rich dark-red glaze, making a pleasing contrast with the rest of the building.

IN the February BRICKBUILDER, under the illustration of the Y. M. C. A. Building, it was stated that the brick for the building was furnished by the Excelsior Terra-Cotta Company. The statement was incorrect, the terra-cotta only having been furnished by the Excelsior Company. The Raritan Hollow & Porous Brick Company, New York City, furnished the gray brick used.

THE NEW CENTRAL HIGH SCHOOL BUILDING, of Detroit, is a structure of which the citizens of that city are justly proud. The utmost care has been used in constructing the building on the most approved lines, and under most up-to-date methods. The building is faced throughout with pressed brick, and the Board of Education, having the matter in charge and adopting the Morse Patent Wall Ties for bonding the same, realized that, considering every feature, this was the most approved form of bonding in use. That they were entirely satisfied with the result is conclusively proven as the ties were also used for the same purpose in the construction of the Delray School Building and Lysander School Building, of the same city. Attention is called to the illustration of the Central High School Building, on page xxxvi.

THE MATAWAN TERRA-COTTA COMPANY is the name of the new corporation which has succeeded the firm of K. Mathiasen & Co. This firm has, until the later part of last year, been doing business at Trenton, N. J., in a leased factory; but with the growth of the company this factory had become inadequate for the amount of business done, and it was decided to move the works to Matawan, where the large pottery and brickmaking plant formerly known as the I. S. Rue Pottery was secured. This plant, with its machinery and four large kilns, is admirably fitted in every respect for the manufacturing of architectural terra-cotta.

The Matawan Terra-Cotta Company is composed of all the old members of K. Mathiasen & Co. Karl Mathiasen, the president and general manager, has been known for many years in the terra-cotta field as a successful manufacturer of architectural terra-cotta. He is also the president and general manager of the New Jersey Terra-Cotta Company, of Perth Amboy, N. J. The other members of the company, the Eskesen Bros. are well known throughout the terra-cotta trade as enterprising and progressive business men.

TERRA-COTTA DETAIL, BUILDING FOR WM. WEIGHTMANN, PHILADELPHIA.
Willis G. Hale, Architect.
Made by Standard Terra-Cotta Company.

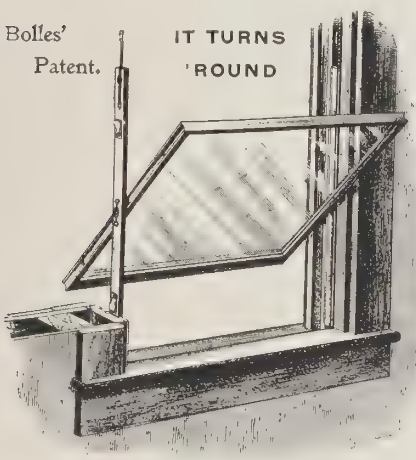
The Boston agents of this concern are G. R. Twichell & Co., 19 Federal Street.

A MEETING of the Philadelphia Brick Manufacturers' Exchange was recently held in the Master Builders' Exchange, when a scale of

prices for brick during the ensuing year was formed. The meeting was attended by the members of twenty firms in that city, representing three fourths of the brick manufacturing interests of the vicinity. The scale agreed upon places the price of salmon brick at from $5.50 to $6 per thousand; hard brick, $7 to $8; stretchers, $9 to $13; pressed brick, $17 to $19, and pressed stretchers, $12 per thousand for the average haul. The brick production for the past year was about 400,000,000, a decrease of about 40,000,000 over the preceding twelve months, caused by some of the yards becoming exhausted and the firms owning them going out of business.

A NEW REVOLVING SASH.

IN every large city there occurs each year a number of fatalities through the operation of cleaning the windows of the large buildings from the outside, and we are glad to call the attention of our readers to the Bolles Sliding and Revolving Sash, as being a device which will eliminate all such danger and render accident from this cause an impossibility.



This window is so constructed that both sides of it may be cleaned from the inside. It can be revolved, reversed, or placed at any desired angle whatsoever for the purpose of ventilation, besides sliding up and down the same as any ordinary sash. To turn the window, reverse it, or place it in a slanting or horizontal position, all that is necessary to do is to raise the sash slightly, and then push the bottom rail outward.

In order to obviate all possible rattling and to render the sash both wind and dust proof, a special device is attached to each end of the strips which press firmly against the window jamb. The sash is snugger and closer fitting by far than the old-style sash, and runs with equal ease and smoothness. The joint is self-locking.

The upper sash is similarly constructed as the lower, and both sashes may be turned either way, separately or together.

The patentees call particular attention to the following important points: Its simplicity, the entire absence of complicating mechanism, the fact that it can be hung with as great ease as the old-style sash, its low price, and the doing away with all the dangers incident to the cleaning of windows.

Further information in this matter may be obtained from Edward Diggs, General Agent, Builders' Exchange, Baltimore, Md.

FOR SALE.

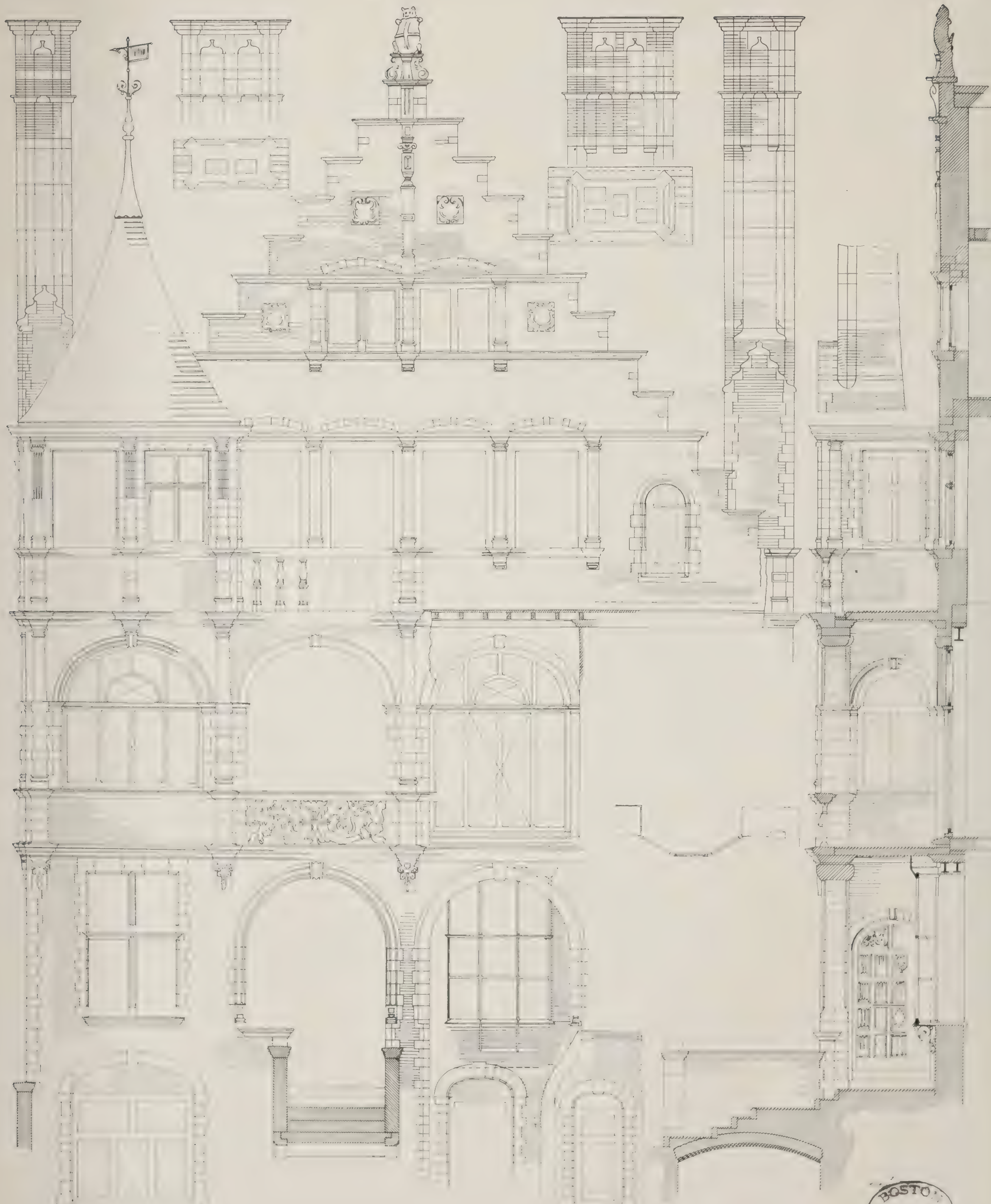
TWO COMPLETE OVER-GEARED 8 FT. DRY PANS. WITH 48-IN. PULLEYS, ENTIRELY NEW.

FOR PARTICULARS INQUIRE OF SMITH & CAFFREY, SYRACUSE, N. Y.

AGENCY WANTED.

A GENTLEMAN having well-located office in Boston would handle some building specialty as side line; is in thorough touch with building work throughout New England, and has good acquaintance among architects and builders. Would prefer something in fireproofing or structural work. Address, SPECIALTY, care THE BRICKBUILDER.

INDEX TO ADVERTISEMENTS.

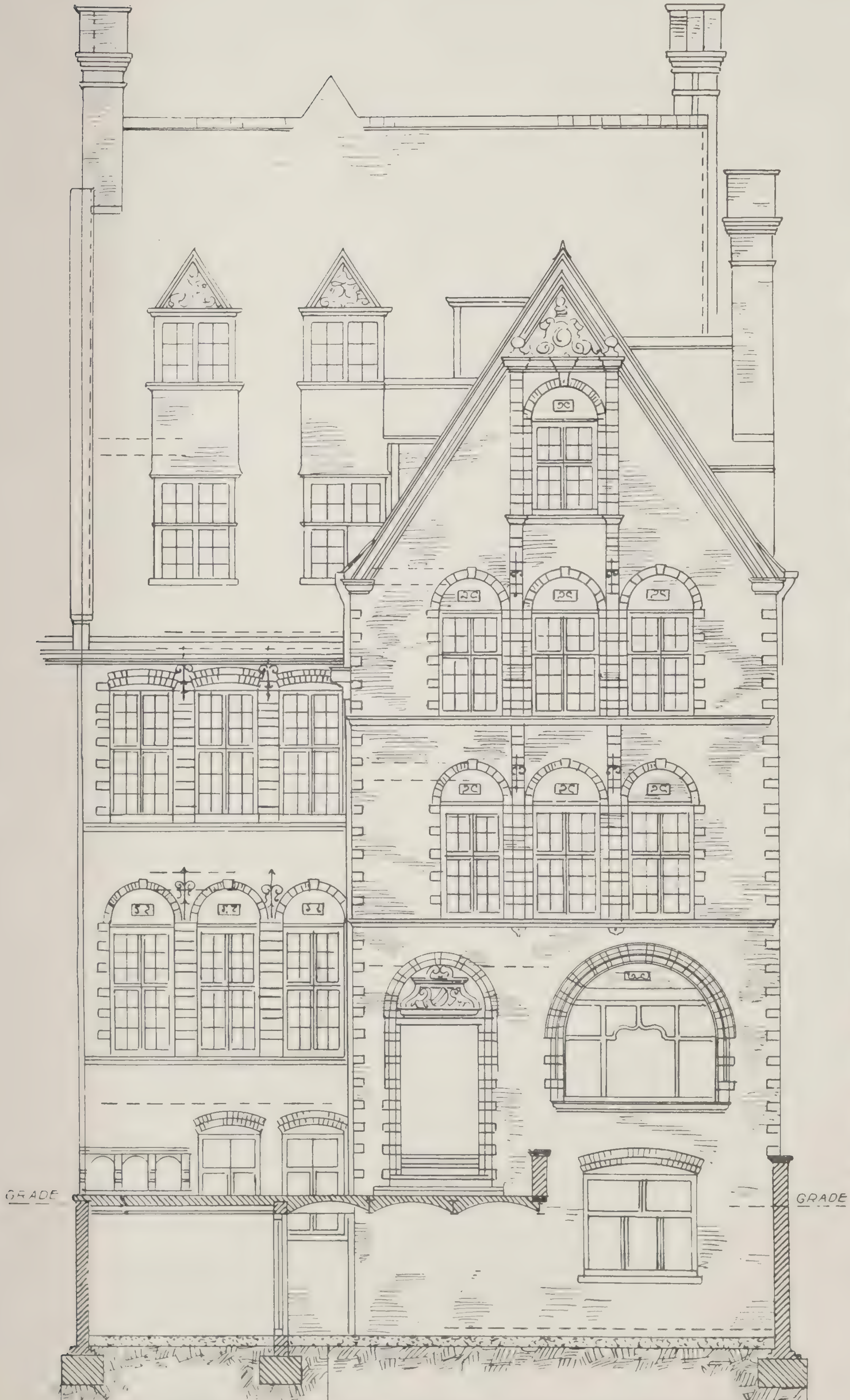


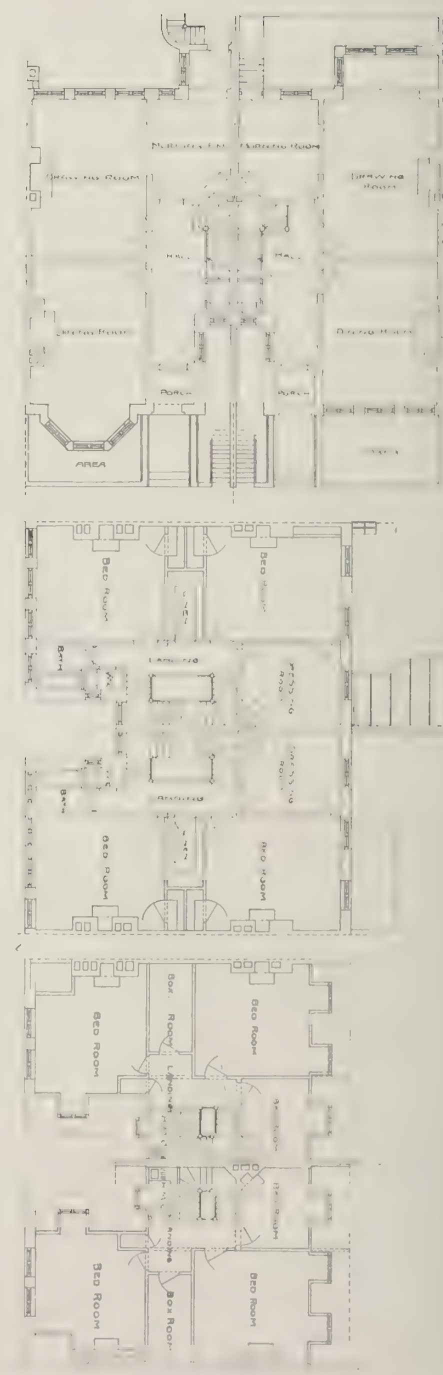
DETAILS OF RESIDENCE, COLLINGHAM GARDENS, LONDON, ENGLAND.

ERNEST GEORGE & PETO, Architects.

VOL. 6. NO. 3. PLATE 26.

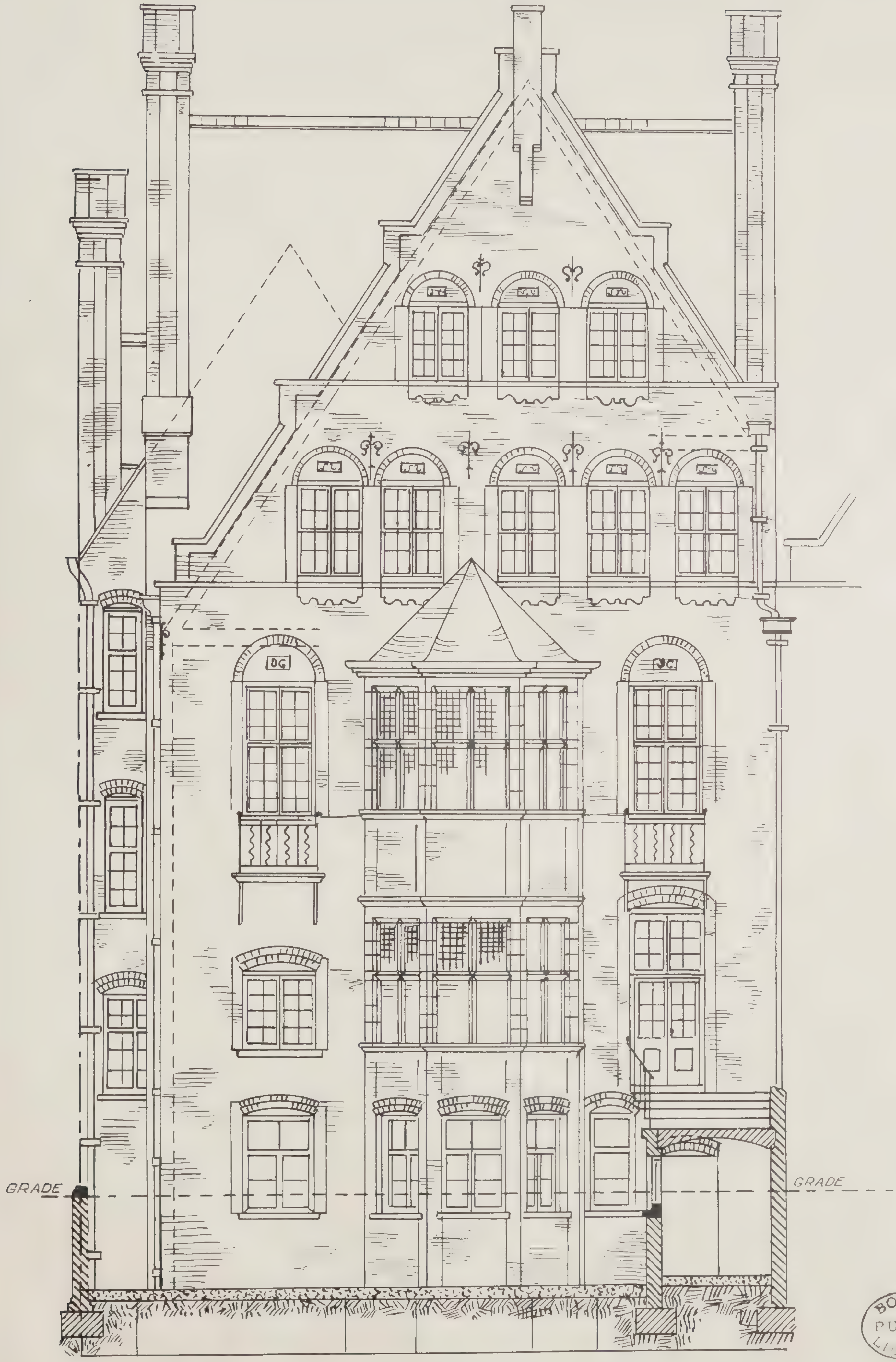
DETAILS OF RESIDENCE, HARRINGTON GARDENS, LONDON, ENGLAND.
ERNEST GEORGE & PETO, Architects.





FLOOR PLANS OF
RESIDENCES SHOWN ON
PLATES 29 AND 30.

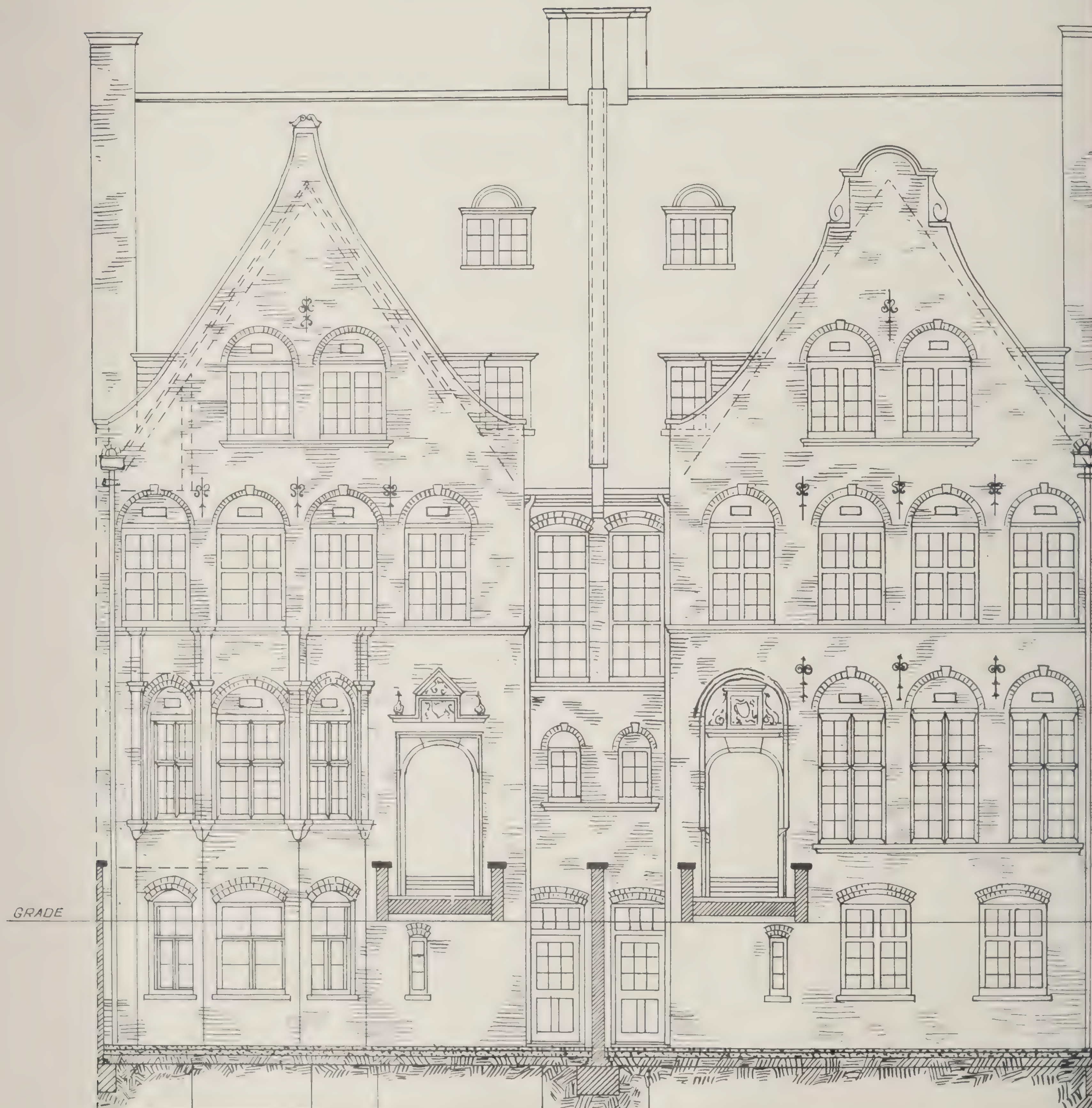
FRONT ELEVATION.
RESIDENCE, COLLINGHAM GARDENS, LONDON, ENGLAND.
ERNEST GEORGE & PETO, Architects.



BACK ELEVATION.

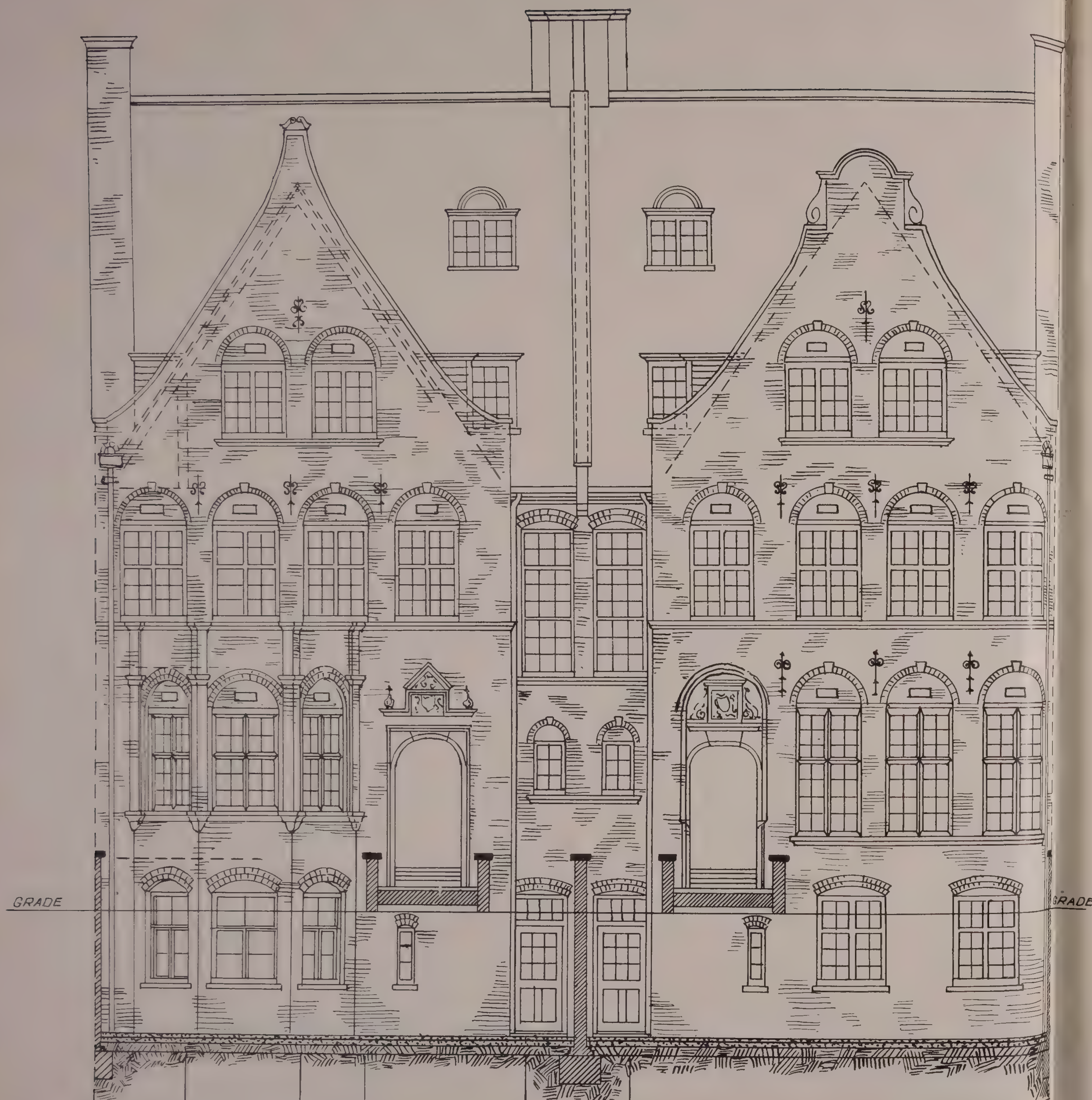
RESIDENCE, COLLINGHAM GARDENS, LONDON, ENGLAND.

ERNEST GEORGE & PETO, Architects.

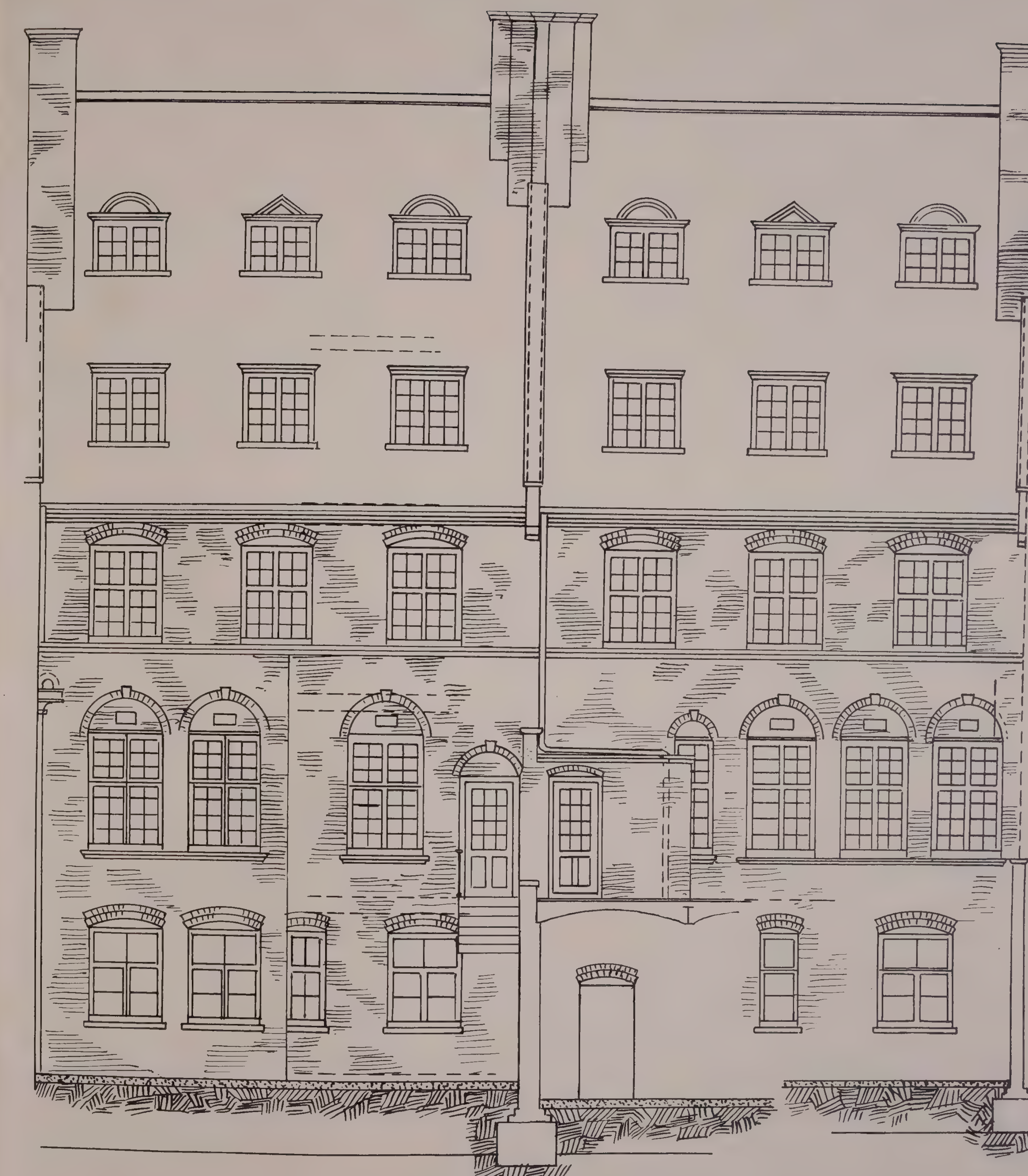


FRONT ELEVATION.

RESIDENCES, COLLINGHAM GARDENS, LONDO

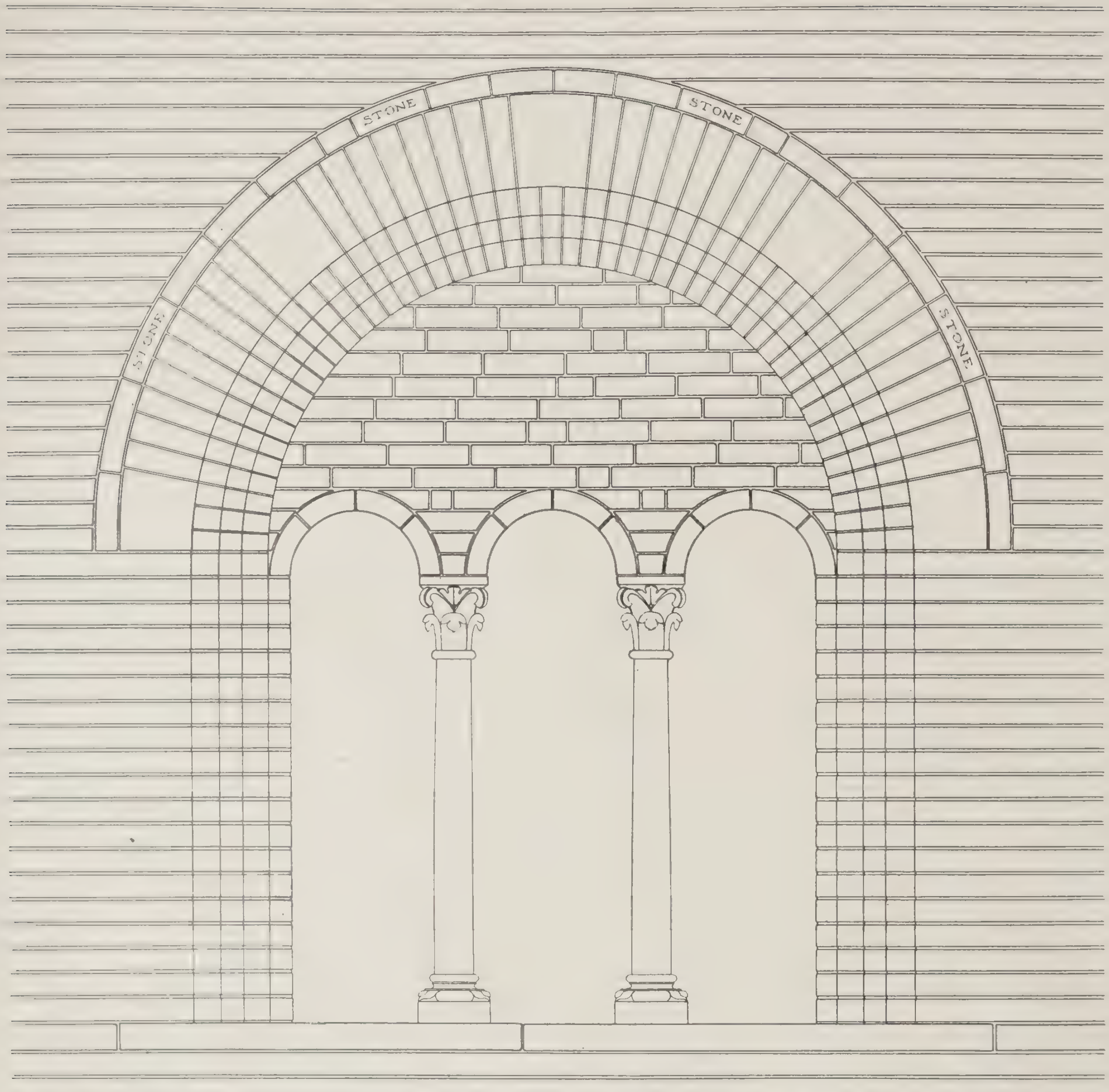


FRONT ELEVATION.



BACK ELEVATION.

RESIDENCES, COLLINGHAM GARDENS, LONDON, ENGLAND. ERNEST GEORGE & PETO, Architects.



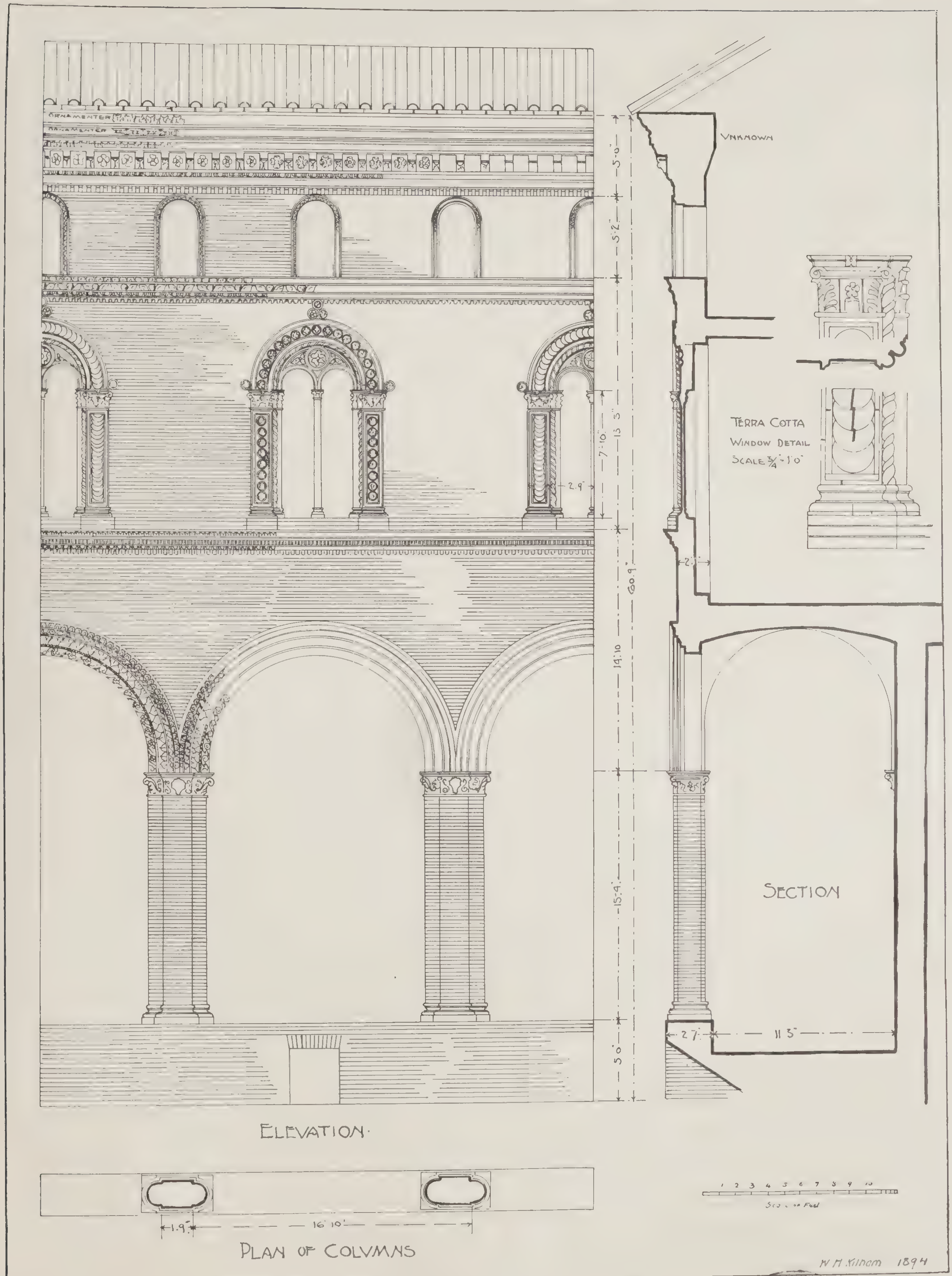
ELEVATION

PLAN

SCALE

NOTE. Voussoirs Brick and Sandstone.
Columns and Sill Stone.
All other Work not marked differently, of Brick.

MEASURED DRAWING OF WINDOW IN SOUTH SIDE OF MUNICIPIA, MONZA.
THIRTEENTH CENTURY.



PALAZZO FAVA, BOLOGNA.

MEASURED AND DRAWN BY WALTER H. KILHAM, ROTCH SCHOLAR.

VOLVME VI APRIL 1897 No. 4

THE BRICKBVILDER

OFFICE 85 WATER STREET BOSTON

THE BRICKBUILDER.

AN ILLUSTRATED MONTHLY DEVOTED TO THE ADVANCEMENT OF ARCHITECTURE IN MATERIALS OF CLAY.

PUBLISHED BY

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BRICK BRACING.

THE constructive importance of brick masonry has during the past twenty years undergone several distinct modifications. Before 1880, the approximate date when skeleton construction first made its appearance, the masonry construction was depended upon to resist static loads as well as to afford rigidity to walls when subjected to lateral or angular strains. The principle was entirely one of inert resistance to thrusts, and the mass of masonry by its cohesion and dead weight afforded the required stability. The introduction of the steel frame brought about what at first seemed to be a radical change in the function of masonry, which from being a supporting member was considered simply as an envelope, a protection, or a mere external adornment to the hidden vital sinews of steel; and all of the calculations of recent years which have been made looking to a determination and resolution of wind strains have assumed that these are taken care of entirely by the bracing or the arrangement of the members of the steel work. There is, however, another function which brick masonry in these modern structures should possess, the necessity for the observance of which is being recognized by our constructors. In the newspapers, which often reflect only a suggestion rather than an exact statement of fact, we sometimes read that a certain building is constructed so strongly that if it were set up on edge it would not distort, and that to all intents and purposes the high building, if properly constructed, is practically a huge cantilever or beam, the lower end of which is thoroughly fixed in the ground. There is no scientific reason to believe that this is an exact statement of fact, and yet after the steel frame has been calculated to provide for every possible strain that would theoretically come upon it, the building receives an enormous addition of rigidity by reason of the brick filling which is added to it; and if, as is the practise in much of the work, the supporting and bracing members are reduced to a minimum expanse of cross section and thoroughly built around by the masonry so that the bricks can tie in through all the parts of the frame, the resulting rigidity is a very considerable element in the stability of the structure. Any one who has had occasion to investigate the stiffness of the steel skeleton before the terra-cotta floor arches and the brick envelope are in place must have noticed the extent to which the frame is affected even by the rumbling of passing teams in the street, and in a high wind the steel frame is jarred very perceptibly; whereas in the completed structure, when the steel frame is properly housed in the brickwork and the floor arches are thoroughly laid, even the tallest of the buildings which have been erected within recent years are not perceptibly affected by the most severe gales, while they seem to be absolutely unresponsive to any jarring or rumbling caused by teams on the surface of the ground. In other words, while the steel skeleton has in a sense replaced a very considerable portion of the constructive value of brickwork, by itself it is not sufficient to afford the necessary rigidity required in a modern structure, and the brickwork plays a very vital part in making the building habitable, and preserving it from the vibrations which in time would cause disintegration if not destruction. We have in mind at this moment a sixteen-story office building which was constructed by a firm of architects who are acknowledged masters of their profession, in which the system of cross bracing to provide for vibrations and wind strains was carried to the scientific limit, the brick walls being treated, however, merely as curtains, and reduced to the least possible areas of cross section, with the result that after an occupancy of a little over a year the vibrations in the building were found to be so great that it became necessary to build two heavy brick cross walls inside of the building from foundation to roof in order to acquire the needed stiffness. In another very prominent building, the movements of the steel frame before the brickwork was in place were such that it was not thought prudent to even build in the floor arches until after the external walls were carried to a considerable height, lest the action of the wind upon the floor surfaces should bring undue strain upon the steel work. These examples illustrate the necessity of care and good workmanship, and serve to emphasize the constructive functions of brick masonry, even when the envelope is carried independently by a scientifically designed steel skeleton.

THE QUESTION OF COLOR — A CONTRAST.

A POPULAR belief does not differ from a popular skepticism in point of endurance. When once fairly established, it becomes a cherished habit of thought, and whether right or wrong, is not easily effaced. It clings to the imagination and continues to influence our judgment in spite of overwhelming facts to the contrary. The evidence of our own eyes, though admittedly conclusive in ordinary affairs, is not always sufficient to eradicate a prejudice of long standing. "Give a lie twenty-four hours' start, and it will have accomplished its mission before the truth has overtaken it." This maxim, though formulated by an experienced politician, has a substrata of truth, and may be accepted — in this case *cum grana salis*. It

is notably the case in regard to the supposed want of uniformity in the color of terra-cotta, when compared with that which may be relied upon in stone taken from the same quarry. Yet the facts do not justify any such sweeping conclusion. We have seen terra-cotta rejected, or what is nearly as bad, belied, on these grounds, though it was not less uniform in color than stone which had been accepted and set in the same building without a murmur of complaint. In like manner we have seen stone accepted simply because it was stone, when the same variation in color would have been deemed sufficient cause for the rejection of terra-cotta. Or, if its use had been permitted at all, it would have been under protest, and after the whole vocabulary of opprobrium had been exhausted. Such is the force of unreasoning prejudice. In this respect, at least, the captain's "choleric word," coming from the mouth of a corporal, is still held to be "flat blasphemy."

Whatever may have been the relative condition of things, say ten, or even five years ago, they have undergone changes in the interval of which the general public — even the building public — are not fully cognizant. Not only have they changed, but there is good reason to believe that they have in many instances been reversed. Indeed, the signs pointing in the direction of this reversal are so general and emphatic that their existence cannot much longer remain a subject of debate. We will give a few of them for the benefit of any one who may doubt this proposition. We would invite him to take an impartial look at the Sixth Avenue entrance to the Siegel-Cooper Building. Plate glass and steel constitute most of the first story, but the elaborate entrances are limestone. All other parts of the immense building are cream-white terra-cotta and brick of remarkable uniformity. We need not rest our contention on any isolated example, for instances of this kind are becoming plentiful, and they are not confined to buildings of minor importance.

The new Astor Hotel, on Fifth Avenue and 34th Street, now approaching completion, is an operation of such magnitude and grandeur that the adjoining Waldorf appears little more than an annex. The prevailing color in this case is a glowing hospitable red. The predominating material is terra-cotta. Seventeen stories of Flemish Renaissance towering into space, and terminating in a highly picturesque sky-line. Fourteen of these stories are red terra-cotta and red brick, the three lower stories being stone of varying degrees of redness. The *absence* of uniformity in the color of the stone is sufficiently marked to attract the attention of a casual observer. It becomes more aggressive if he lingers long enough to inquire into the cause, or speculate upon its ultimate effect as an aptly instructive object lesson. Tenacious indeed must be the popular belief, or delusion, that survives the shock of this silent, unanswerable demonstration.

At first sight it might be surmised that the stone had been obtained from at least two quarries, but we have been assured that this is not so. It is of course supposed to be cut in a way that will permit it being set on its natural bed, but this good rule may not have been adhered to in all cases, and wherever departed from, in addition to being less durable, we get a different texture, which would to some extent account for the difference in shade. The method employed in working the stone is another element that has now to be reckoned with, viz., whether it has been tooled by hand or by machine labor. A conspicuous case of this kind may be seen in the cartouche window transoms on the westerly side of the 34th Street elevation, which, being richly carved, represent the color effect produced by hand labor. The contrast presented by the work on the intervening piers, which has evidently been tooled in a mill, is very decided. The more delicate touch of the carver has cut without abrading, leaving the grain of the stone favorable to the absorption of light. The automatic and less sympathetic action of the machine has stunned the surface of the stone, producing an entirely different effect, which, in turn, goes far to produce a difference in color, that otherwise would not have been so pronounced. But it must be remembered that this is in stone; and being so, we are expected to close our eyes to its defects and shortcomings, lest anybody should think us capable of flying in the face of nature.

We may not go so far as the satirical Mr. Whistler, who, when a patron remarked that a certain landscape called to mind one of his pictures, replied, "Ah! I'm glad to hear that nature is learning. But we will go far enough to assert that men are learning to assist nature by taking advantage of nature's laws and of nature's bountiful store of raw material in the production of building blocks more even in color, and altogether free from the laminations inherent in her own product.

THE removal of brick edifices which were erected in the early part of this century often causes comment upon the thorough manner in which many of them were constructed. While there are numerous exceptions to this rule, and it by no means follows that all of our old buildings were well built or substantial in character, it is true that the work of the early part of this century was in the main of a very high constructive value. This was due largely to care and intelligence in the use of material, but also quite largely to ignorance. With the idea of making things strong enough, a pier or wall would often be made widely in excess of the exact strength required. It is only within quite recent years that the extent to which first-class brickwork can be loaded has been fully appreciated. The practise twenty or twenty-five years ago was to allow a load of not more than 6 or 7 tons per square foot bearing upon thoroughly first-class brickwork, whereas now by law in Boston we are allowed to put as high as 15, and judging by experiments which have been made at Watertown and elsewhere, there would be a sufficient margin of safety in some cases if the bricks were loaded to 25 tons per foot. This, of course, implies the utmost care in construction, with the best of mortar and intelligent bonding of the bricks. While the statute limitations are advisable, the tendency of modern building methods has been to reduce the factor of safety in proportion as the extent of positive knowledge of resistance of materials has increased; and whereas in the days of our forefathers the intelligent engineer would use a factor of safety of 6 to 10, we are now perfectly content with one of from 3 to 4, and this with our best modern constructors is really a factor of safety, based upon actual knowledge, and not a factor of allowance for ignorance.

ILLUSTRATED ADVERTISEMENTS.

THE accompanying triple window is one of four used in a block of high-class residences in New York City, of which Messrs. Neville & Bagge are the architects. The illustration shows the work set up temporarily just as it came from the kiln, and previous to its being shipped along with other work of equally good design, from the works of The New York Architectural Terra-Cotta Company.

CHARLES T. HARRIS, LESSEE, takes a full page (xxvi) this month on which to give a partial list of buildings which have been roofed with the Celadon Terra-Cotta Company's tiles. This page will be found to be of especial value, as not only is the name of building given, but location, style of tile used, and architect, as well.

Brick and Terra-Cotta at the League Exhibition.

THE annual exhibition of the Architectural League of New York offers an excellent opportunity for studying the tendencies of current work and for observing the lines upon which study for future work is being conducted. The exhibitions held by the league have every year grown in interest and in scope, and the one

HOUSE FOR DR. J. W. PUTNAM.
Green & Wicks, Architects.

which closed the fifteenth of last month is quite in the line of regular progression, including work from many parts of the country, and to a very considerable extent representing the best talent of the profession. As in previous years, a considerable space is devoted to the work of the so-called allied arts, a term which can be conveniently stretched or restricted to suit almost any desired classification. Had the exhibition been confined more closely to purely architectural effort, it would in some respects have been more interesting to the architect, though, judging by observation the day we were in the galleries, the arts and crafts attracted more visitors than the drawings, and the combination is always a good one even if it goes no further than to show how haltingly architecture has developed of late years by comparison with the sister arts.

The first impression given by the architectural portion of the exhibition is that an immense amount of work has been expended by exhibiting architects merely for the production of show drawings, which, as far as actual study or application to real architecture is concerned, have a relatively slight value. Many of the drawings are overdone, and not only is a great deal of detail work suggested, but a great deal is actually put on drawings which, if they were rendered more lightly, with less attempt to produce pictures, would in many cases gain directly in proportion to the simplicity of treatment. This is emphasized by the few, but very large French drawings which are exhibited together at one end of the hall, which, however one might criticize the design, are certainly rendered in a style which somehow or other seems to be acquired only in Paris, the least possible work being expended to secure the greatest effect. The over-working of the American drawings seems to be specially noticeable in connection with the buildings which are intended to illustrate brick or terra-cotta designs. Brick suggests color, and color evidently means paint, for the majority of the brick drawings shown are very strongly colored, and instead of being indicated, the tones are laid on with a heavy brush. Somehow, simplicity and terra-cotta are hard to combine on paper, at least, and though a quiet, dignified treatment is naturally associated with brick, when we begin on terra-cotta the details run riot; and the knowledge that ornament will repeat so easily in this plastic medium without arousing the bugbear of expense, that *bête noir* of true art, seems to limber one's fingers and stimulate one's inventive faculties until it requires firm repression and deliberate self-control to abstain from encoring one's designs.

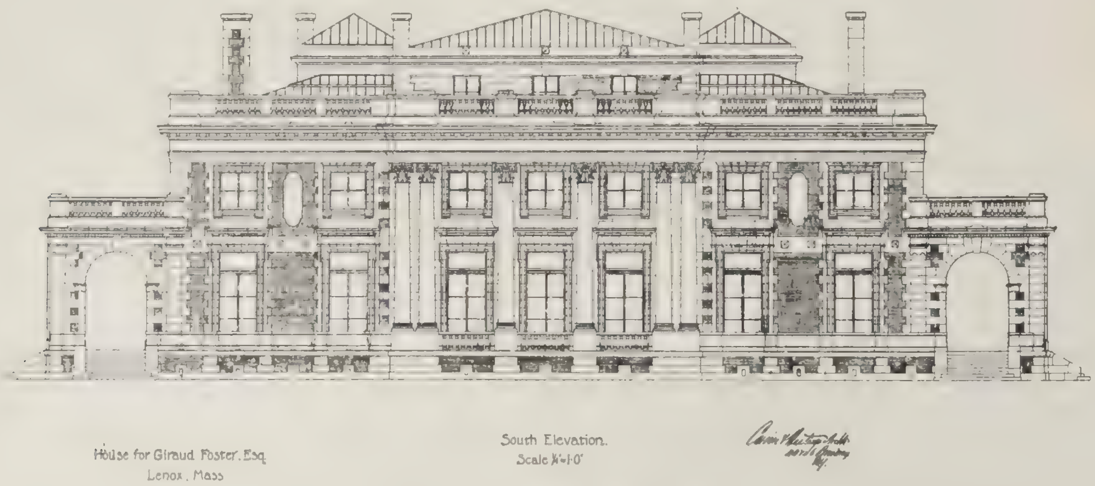
Brick and terra-cotta alone, and in combination with other materials, were very much in evidence in the exhibition, — indeed, we cannot recall any collection of architectural designs in which so large a proportion were intended to suggest burnt clay. And this is speaking simply from the external evidences. Undoubtedly there were many drawings which were intended to represent brick or terra-cotta, but which for the purpose of the exhibition were not specific. The distinction in style between stone and terra-cotta is one that is seldom made in a perspective drawing, and consequently many designs which have the appearance of monumental stonework may be intended in the mind of the designer to be worked out in terra cotta; so that while terra-cotta work, as such, was not specially prominent, there were a quantity of designs which one would reasonably expect to be carried out in clay, though there was less special attention to giving it a terra-cotta character than we would like to see. But of brick there was a lot, and on the whole very satisfactory. One of the first designs near the entrance of the gallery was the government drawing of the proposed post-office at Pawtucket, a combination of brick and stone worked out in a quiet, dignified manner and forming a very pleasant composition. And, by the way, what a relief it is to feel that at last we have a government architect who is competent to design a creditable building! There were exhibited two other post-offices due to Mr. Aiken's taste, that at San Francisco and the one at Pueblo, Cal.,

DESIGN FOR A BROKER'S OFFICE.
Wilson Eyre, Jr., Architect.

both of which are admirably designed, seem fitted for the location, and are in marked contrast to the stuff which the government architect's office has put out in the past. And to think that we, of Boston,

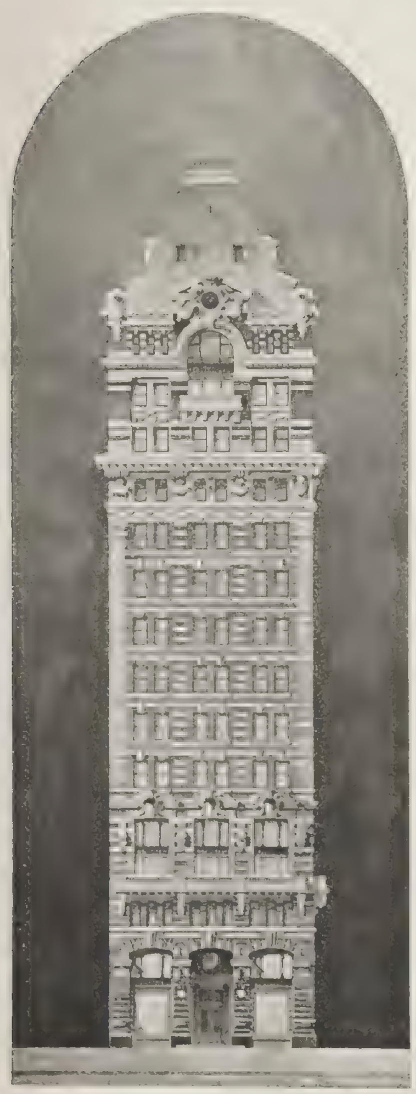
have that horrible, cold granite monstrosity for a post-office, which is too solid to wear out, is not built to burn, and we cannot hope that a providential cataclasm will ever remove it from our midst!

The drawings exhibited by E. Raymond Bossange, of the house



HOUSE FOR GIRAUD FOSTER, ESQ., LENOX, MASS.
Carrère & Hastings, Architects.

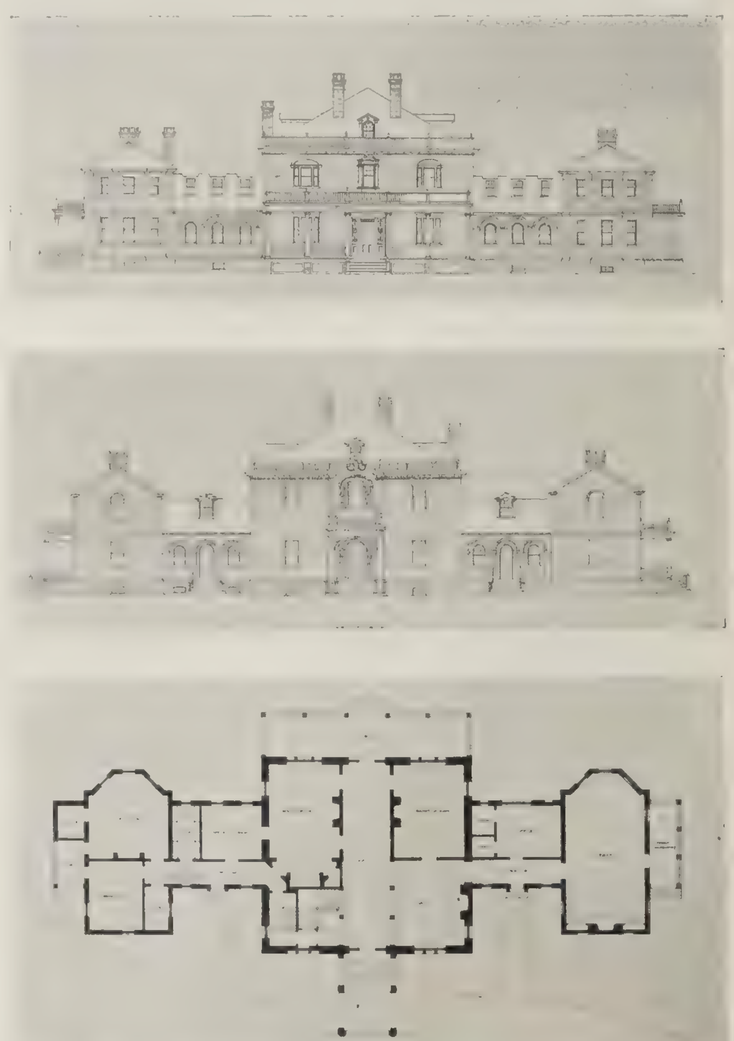
at Scarborough-on-the-Hudson, presented a charming combination of brick and half-timbered work, rendered in the most delicate water-color, and affording, with its green roof and polygonal tower, a charming composition in color. The house is perched on a high knoll, with irregular plan, permitting of a large brick tower; the lower story is all of brick, the upper stories half timbered and plaster work. Close beside this was a design by Edward P. York and Philip Sawyer, for a recitation hall at Vassar, a straightforward, well-worked-out Elizabethan composition of red brick with stone trimmings. Longfellow, Alden & Harlow exhibited a drawing of a large house at Alleghany, also in red brick, with an added red tone in an intensely strong tile roof.



DESIGN SUBMITTED FOR WASHINGTON LIFE INSURANCE COMPANY BUILDING.
Walker & Morris, Architects.

One of the most charming studies in the exhibition was Carrère & Hastings' house for Giraud Foster, at Lenox. It is indicated to be constructed of brick, with trimmings of light stone or terra-cotta, and is thoroughly delightful in every respect, with a carefully studied academic setting, not shown in the cut which we publish herewith. The drawing exhibited was rendered in full color with all the accessories, and the accessories are so charming that one questions whether the trees and shrubbery which are shown to such an advantage were planted for the house, or whether the house was planned to come so nicely between such well-balanced, mighty oaks. As an example of the possibilities of an architectural treatment of masses of foliage, and of symmetrical gardening, it is eminently successful.

The design for York Hall, New Haven, by Grosvenor Atter-



COUNTRY HOUSE AT RINGWOOD, N. J.
Thomas Henry Randall, Architect.

bury, which was hung close to Carrère & Hastings' design, showed a Venetian treatment of buff brick with an elaborate central motive and a crowning story richly worked out apparently in terra-cotta. Collegiate buildings, by the way, seemed to be quite plentiful in the exhibition. Another recitation hall for Vassar, shown by Rossiter & Wright, was a simple, well-studied design, in the style which seems to have come to be accepted as the American Collegiate, a pretty straight adaptation of the best features of the English Tudor Collegiate buildings. Lamb & Rich exhibited their design for Barnard College, New York, a strong, restrained, well-studied effect in brick.

Of a very different kind was the perspective showing the garden and wing to Union League of Philadelphia, Keen & Meade, architects, a strong composition in yellow brick and white stucco, recalling somewhat the feeling of Southern Spain, or Pistoja, with a foreground formed by a simple garden, charmingly arranged, with a fish pond in the center. The drawing, by Hughson Hawley, is a very striking one, both in composition and rendering. It is a pity that it should have been hung so high, and so immediately over one of the partitions of the alcoves that it was hard to get a really fair view of it.

The country house in Maryland, by T. H. Randall, architect, which we publish herewith, is the kind we should be glad to see more of, and it shows that Mr. Randall has studied to excellent advantage the brick country houses of the South. It was a delight to find these straightforward, direct elevation drawings in the midst of highly colored perspectives. After all, though clients demand a perspective, and are easily caught by brilliant coloring or effective if impossible effects of light and shade, the real study is shown on the elevation drawings. Green & Wicks appreciate this, as is evidenced by the happy design for house for Dr. S. W. Putnam, also published herewith, a very successful treatment of a city house.

Mr. Bruce Price exhibited an interesting design for the St. James Office Building, which attracted considerable notice, and which presented a very successful decorative feature in the use of colored brick diaper work. The unfortunate results which accompanied the use of this treatment in the church which formerly stood on the corner of 42d Street and Madison Avenue, which gained for it the designation of the Church of the Holy Oil Cloth, have prevented a fair recognition of the effectiveness of this method of decorating a wall surface, and it is encouraging to see that some of our best architects are returning to this perfectly legitimate system of color treatment. Mr. Price also exhibited a large drawing of Mr. George Gould's house at Lakewood.

RESIDENCE OF CHAS. E. BUZBY, ESQ.
R. G. Kennedy, Architect; Kennedy, Hays & Kelsey, Philadelphia.

The office buildings exhibited were less distinctively of brick and terra-cotta, though there was Walker & Morris's design for the Washington Life Insurance Company Building, in brick and terra-cotta, and the proposed Woman's Hotel, by Gannon & Hands, in buff, or old gold brick and light terra-cotta (?), the drawing of which was very strong in tone with a color effect helped out by the banners at top of the building.

A building we should have liked to see illustrated to better advantage was the new Astor Hotel, Fifth Avenue, adjoining the Waldorf, both by Mr. H. J. Hardenberg. The combined Fifth Avenue fronts were shown on a single highly rendered elevation, the scale of which was, however, too small to do justice to the beautifully designed and executed terra-cotta details. The 35th Street front of the Astor Hotel is an especially good example of the best and most recent adaptation of terra-cotta and brick. The new Delmonico, by James Brown Lord, is another building presumably in brick and terra-cotta which was tantalizingly suggested rather than shown by a large rendered drawing in full color.

Philadelphia was well represented. Cope & Stewardson exhibited a design for a city residence, conventionally treated, in thoroughly good taste, well balanced and exquisitely proportioned. This was indicated as in red brick with white trimmings. After all, there is a good deal of satisfaction in being able to revert to a type and polish away on that type until the proper degree of finish is attained. Wilson Eyre, Jr., contributed one of his charming studies, designated as "A Design for a Broker's Office." Mr. Eyre is so unique in his style, and his work has such a delightful personal quality, it is always anticipated with pleasure. The drawing seemed to indicate purple-black brick. It is quaint, jolly, convivial, representing just the sort of structure we would expect some of Howard Pyle's

characters to inhabit, and to issue from with church-warden pipe and bowl of punch for solace. The residence by Mr. R. G. Kennedy is a picturesque, sunny treatment of a city front, one of the few designs exhibited which showed a use of terra-cotta roofing tiles.

Howard & Cauldwell exhibited an interesting drawing for a church at New Brighton, Staten Island, showing a very conscientiously developed design in gray brick and Spanish roof tiles. The brick might be buff or gray, the drawing being graded in different parts. The building is Romanesque in style, recalling some of Vaudremer's work, with large windows on the sides separated by buttresses, diaper work of deep red brick in the spandrels, and the same deep red or orange tones carried out in the tympanum of the door. The door itself was painted on the drawing a bright green, affording a very emphatic contrast, which, however, was warranted by the general result. The plan is a very irregular one, with the tower on the side, and the whole church, while perfectly individual, suggested in arrangement and design S. Pierre de Montrouge, Paris, but without the coldness of the French church.

As a scheme of color treatment may be noted a design for three residences, in a single block, by Marcus T. Reynolds, showing a high basement of rusticated terra-cotta in simple courses, and a perfectly plain brick surface above, the whole in a monotone of gray buff except for streaks of strong red marble used as mullions of the windows of the upper story, adding just enough emphasis to relieve the tones of brick.

Around the central gallery of the exhibition rooms were placed eight terra-cotta columns with Ionic capitals, the whole standing 8 or 10 ft. high and executed in a light-colored buff. The workmanship, while not perfect, was so nearly so as to recall the days, not so very long ago, when such true work with evenly matched flutings and symmetrical entasis would have been impossible in terra-cotta. These columns were set up apparently without any mortar, but seemed to stand perfectly true, and were excellent examples of what can be done with the material.

The exhibition showed by inference our national timidity in the handling of color. When we undertake to indicate color, we do not, like the Japanese, use real color, but rather make colored pictures, a distinction which will be appreciated by any one who has tried, for his own satisfaction and without any reference to what a client wants or thinks, to study out on paper in advance the actual colors which should be used in a chromatic treatment of a front. It is really a question how far we can to advantage undertake to study in perspective, for if we apply color directly to a perspective without graduations it ceases to have the effect of a picture, and pictures are what clients and exhibitors demand. The real study can to best advantage be put upon the elevation, as is shown by Mr. Price's excellent study of the old house at Lakewood, which is in direct elevation, and from an architectural standpoint shows the building to a great deal better advantage than any perspective could possibly do.

The exhibition emphasized a statement which has frequently been made during the past few years, that architecture is not advancing as rapidly as her sister arts, and that within recent years decoration, sculpture, and the applied arts generally, have developed a wonderful vitality and have made rapid strides in every direction, while in architecture we seem to be making way for our artistic craftsmen and perfecting our own art by its accessories rather than by its intrinsic advance. The exhibition shows the tendencies of our public work far better than the actual work itself would make them manifest, for an architect will very often put himself on record on paper where he would hesitate to carry out the same thought in actual practise, and consequently an exhibition of this sort is better able to measure what the architects want to do than if we should go around and see what the same architects were actually doing.

A CITY RESIDENCE.
Cope & Stewardson, Architects. Rendered by Chas. Z. Klauder.

PERSONAL AND CLUB NEWS.

MESSRS. SHEPLEY, RUTAN & COOLIDGE have removed their Chicago office to the Old Colony Building, Dearborn and Van Buren Streets.

CLEVERDON & PUTZEL, architects, New York City, have removed their office from 13 Astor Place to the Hartford Building, Union Square.

H. E. BOUITZ, architect, having opened an office at Wilmington, N. C, would be glad to receive catalogues and samples of building materials.

ON the evening of April 19, Mr. Peter B. Wight, architect, delivered an address before the Chicago Architectural Club on the "Fundamentals of the Development of Style."

THE ART INSTITUTE of Chicago has invited the Chicago Architectural Club to make its home within the Institute Building. Aside from the desirable location, the club will have special privileges in connection with the Art Institute.

Architectural Terra-Cotta.

BY THOMAS CUSACK.

(*Continued.*)

THE twenty-six Ionic columns used on the Hoffman Library, and referred to in a preceding chapter (Fig. 6, page 8), were, we believe, originally intended to carry an entablature and two pediments in the same material. It was afterwards proposed to substitute metal, and this, we regret to say, was ultimately done in the building shown at Fig. 7. If the wisdom that is said to repose in "sober second thought" be open to exceptions, we think that the latter determination should count as one of them. Had the original intention been adhered to, it could have been executed without serious difficulty, and a scheme of construction such as that shown at Fig. 19 might have been adopted with confidence as to the result. This particular cornice is, of course, an incident beyond recall, and we refer to it merely as an abstract proposition, which will serve as a convenient illustration of what may be done in terra-cotta under similar conditions. The methods employed have a wide range of adaptability, and are open to whatever modification may be found necessary or desirable under other circumstances. It will be noticed that in point of detail our design does not differ materially from well-known classical examples, while the construction has been modernized to date of writing, and made not only practicable in terra-cotta, but quite simple of execution.

The two 12 in. continuous I beams constitute the principal support between columns, and will be found ample for the load resting upon them. To the bottom flanges is bolted a series of straps, at intervals equal to the length of the pieces of terra-cotta, and from these straps the blocks forming soffit of architrave are suspended. While these blocks were being pressed they would be made to receive a rod of ½ in. round iron, which, being inserted from the back, would pass through the partitions without penetrating the finished face. Two hangers would then grip this bar as at section *A.A.*, and passing through holes in the strap would be adjusted by tension nuts until perfect alignment was obtained in the soffit. Similar provision would be made for rods in the blocks forming upper portion of architrave, and they in turn would be bolted to I beams through holes previously located, making it possible to have all punching done at the mill, for greater convenience and economy. These rods should be a trifle shorter than the blocks into which they are inserted; all cavities being then filled with cement, each piece is ready for being bedded solidly against I beams, carefully adjusted at the joints, and tightened up to line by means of nut on the inside. Separators should be introduced between the I beams to give greater rigidity, and to prevent any tendency to spread or buckle. The whole of the space between beams should then be filled with concrete, special care being taken to grout down into chambers showing on top bed of soffit blocks, also around and between the straps until every crevice has been filled. These blocks, being now embedded into a concrete core, would no longer depend for support upon the hangers, which, however, would be allowed to remain undisturbed as an extra margin of safety.

We are aware that work of the kind contemplated in this last item is frequently forgotten, or done (if done at all) in a very perfunctory manner. It would therefore require close supervision to ensure its being done uniformly and thoroughly. But, assuming that a reliable brand of cement has been used, and that conscience, as well as the requisite amount of skill, has been put into the work, we would in this way obtain a terra-cotta architrave of composite construction that would be stronger, and perhaps more durable, than a monolith in stone of corresponding section. Cement is an excellent preservative of iron, and the interior skeleton being completely protected from the effects of fire and water, there would be little to fear in the line of deterioration or discoloration from rust.

The inverted tee of light section at *X.X.* would be inserted in joints of ashlar ceiling, which would be made in slabs of convenient length. This has no weight to carry, but it, too, should have its chambers filled, and the top bed floated in cement. Another inverted tee would be inserted at every joint in lower member of cornice, and should extend back some distance into main wall. These cantilevers would carry the direct weight of the top member of cornice, which, having been set to line, should be securely anchored back to roof; the hooks taking hold of a rod, for which provision would be made, as in the case of architrave. In backing up the frieze, the bricks should be built into the chambers of every block; and if this is done, no additional anchors would be required.

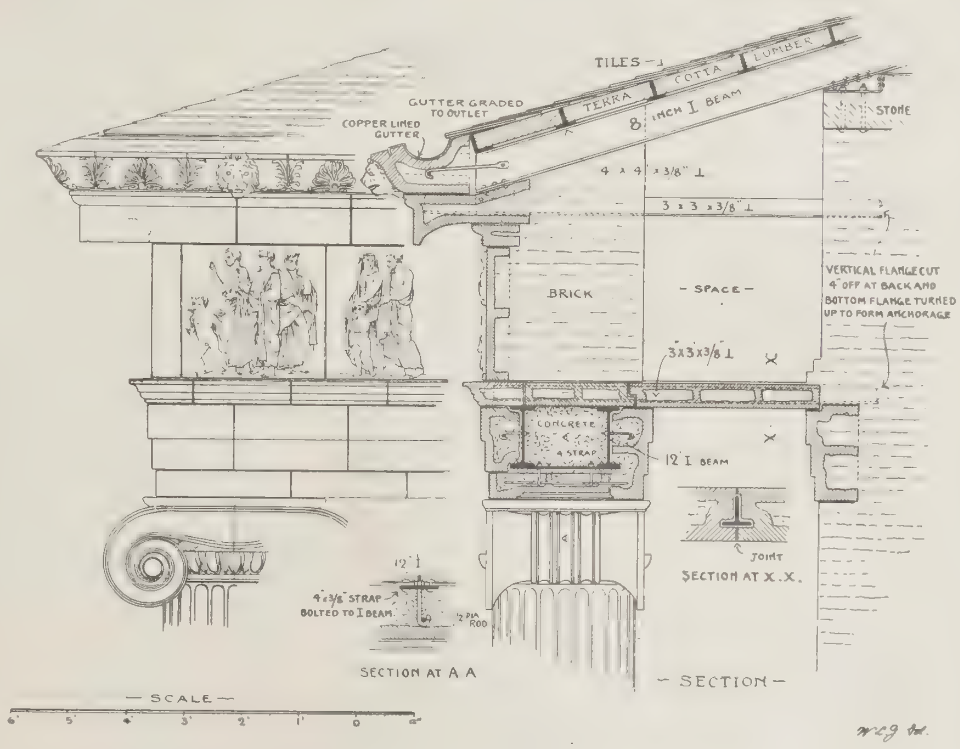


FIG. 19.

The frieze and tympana may, of course, be finished in plain ashlar, where a simple or severe treatment is considered preferable. But in most instances the plasticity of them aterial would, no doubt, furnish tempting inducements for the introduction of allegorical subjects, suggested by and befitting the character of the building. The jointing of the actual work would be much less conspicuous than it has been made to appear in the drawing, in which, as in previous examples, the joints have been intentionally exaggerated. None of these drawings were prepared with any view to pictorial effect. Their primary object is not to clothe or conceal, but to dissect and exhibit the anatomy of the subject. The aim is to show as clearly as possible the exact relationship which one block bears to another, and on what the whole of them must ultimately depend for support. For the same reason we have selected this particular subject, because it embraces in a comparatively small compass a number of the chief difficulties usually met with in work of a similar character. Granted that we are not called upon to duplicate a Greek temple every day, the fact remains that such a thing could be done very successfully. The system of composite construction now proposed does not differ

in principle from that which has frequently been tested on a smaller scale in actual practise. The example before us merely calls for its extension under favorable conditions.

In almost every phase of modern Renaissance work troublesome problems of the same kind are frequently encountered, and, whether we like it or no, have to be met by the adoption of similar expedients. Nearly all the latest and best work is but a free adaptation of classical forms, with very often a literal application of classical detail. Wherever the architrave, frieze, and cornice becomes part of a design, certain portions of it have, at times, to depend upon some form of invisible support. So long as the architrave rests directly on a wall, the making and setting of the work remains a simple affair indeed. But when it has to be carried across openings of considerable extent, between piers, columns, or pilasters, the problem is to all intents the same as the one now in question. In such cases, the solution usually resolves itself into an iron core of sufficient strength, to which is attached a terra-cotta casing.

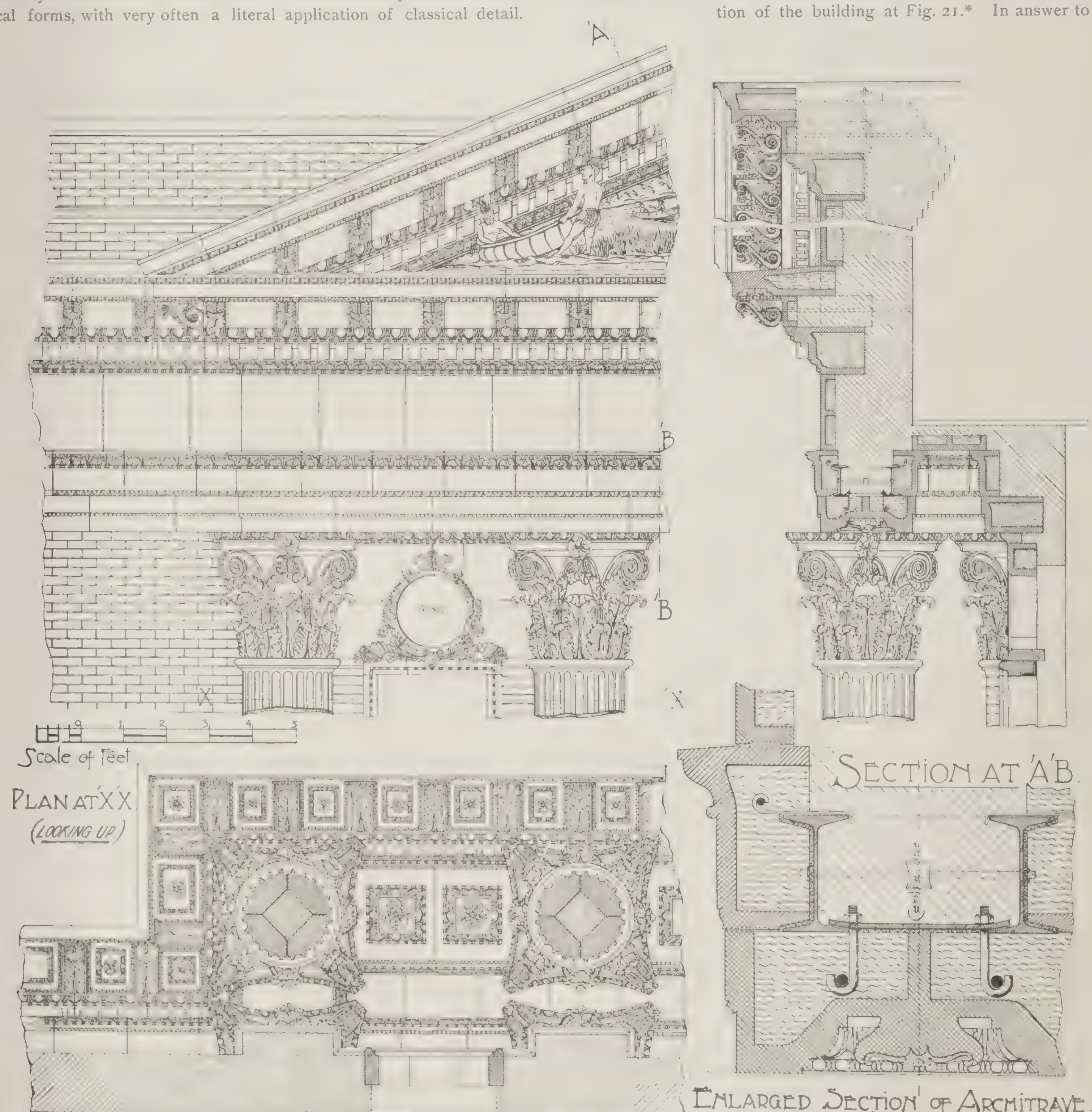


FIG. 20.

G Del

The actual construction of an entablature such as that to which we have just referred is shown in Fig. 20. It was adopted in the erection of the new City Hall, Elmira, N. Y., and when submitted to a practical test was found to work admirably. If any doubt had existed on the point, it would have been set at rest by the very reassuring reply just to hand from the architects, to whom we are likewise indebted for a confirmatory photograph, showing this portion of the building at Fig. 21.* In answer to a specific inquiry on this subject, they write: "In regard to the construction of the terra-cotta, and the manner of supporting it, we would say that we cannot suggest any improvement on the method adopted. It has answered the purpose perfectly, and no settlements

* The scope of our remarks is at present restricted to a somewhat narrow, but very necessary phase of terra-cotta construction. It precludes, for the time being, a more general review of this highly creditable example of municipal architecture. We propose reverting to this building (among others) at a later date; by which time its completion, and the removal of temporary enclosures, will permit of more adequate photographic illustration.

or cracks have developed since the work was finished." In this particular case the soffit was made in single blocks, with a panel and rosette in the center of each, and the joint passing through the center of rail. This allowed the iron rods to be inserted longitudinally, passing clear through the ends and partitions of the block. Separators, bolted at intervals between the I beams, prevent lateral deflection and thereby greatly increase their rigidity. Being held at a uniform distance apart, the flat bars (through which the hangers pass) may be placed where required during the setting, as they merely rest on the bottom flange of each beam and do not need any other fastening.

We cannot be too emphatic in urging the use of cement filling in all work of this kind, and that for the reasons given in speaking of Fig. 19. It has already been spoken of as a good preservative of iron, which it undoubtedly is; but in saying this two conditions are implied which cannot always be had for the asking. To be effectual,

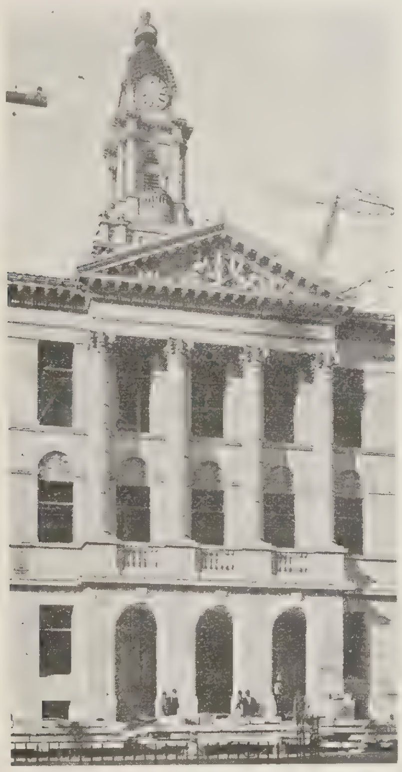


FIG. 21.

the iron should be entirely sealed up in the cement, and it must be well protected from moisture. If allowed to corrode, it then becomes merely a question of time when something must give way. But long before that could happen, the terra-cotta is liable to suffer irreparable discoloration from iron stains. A solution of rust will find its way to the surface, and if accelerated by damp will soon trickle down through joints of soffit, in work such as that to which we are now giving attention.

We think the best way to prevent such an occurrence is for the architect to anticipate it in his specification. This he can do by directing that all bolts, cramps, anchors, etc., coming into direct contact with terra-cotta, be *galvanized*. In much of the work of past ages which we profess to admire, and (in a superficial way) seek to imitate, the cramps and anchors were often made of copper. Similar precautions against oxidation are sometimes adopted in modern work, but the tendency of the times is against burying anything of intrinsic value in places where it will not "show for all it is worth." A deposit of zinc on the surface of the iron usually reaches the limit of allowable expenditure in this direction. It may, however, be trusted to protect the smaller appliances, and with two coats of metallic paint on the larger sections, no serious consequences are likely to ensue.

(*To be continued.*)

Fire-proofing Department.

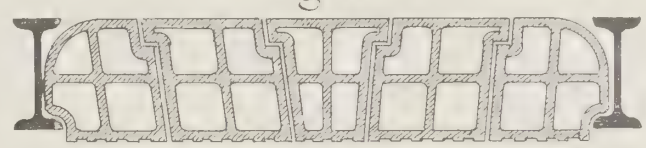
ORIGIN AND HISTORY OF HOLLOW TILE FIRE-PROOF FLOOR CONSTRUCTION.

BY PETER B. WIGHT.

(*Continued from March Number.*)

RESUMING our historical narrative, we find in Edward Dobson's "Rudimentary Treatise on the Manufacture of Bricks and Tiles," printed in London, 1868, a description and illustration of hollow brick construction used in H. R. H. Prince Albert's model houses. These arches were segmental in form, and used to span

Fig. 10.

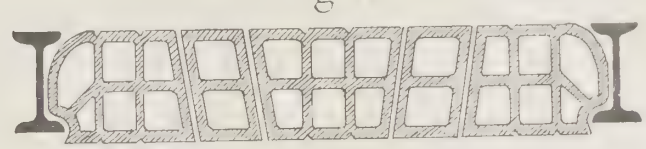


From drawing attached to Roux Frères' Fr. Patent. Mar. 25. 1868.

entire rooms 10 ft. 4 ins. wide. The external springers were of cast iron, built in the brick walls, and connected by wrought iron tie-rods. This construction so much resembles the Bunnett arch that it is hardly necessary to reproduce the illustration. Its main difference is that the joints are straight, and side pressure tiles only were used. The rise of the arch was also greater than in Bunnett's, so that the tie-rods were exposed.

We now come to the invention of Roux Frères, which soon followed that of Garcin. They were manufacturers of all kinds of tiles and hollow bricks at St. Henry, Marseilles, France, and pat-

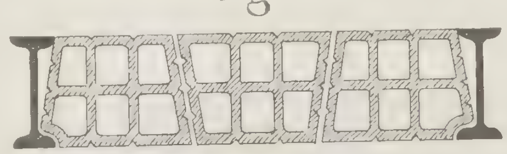
Fig. 11.



ented a flat hollow tile floor and ceiling arch on the twenty-fifth of March, 1868. Fig. 10 is a copy of the drawing attached to their patent.

Their invention was of the nature of an improvement on that of Garcin. They placed alternate notches and ledges at the upper corners of their tiles. They also brought the soffits of the voussoirs below the bottoms of the I beams, so as to allow a thickness of cement between the heels of the springers and covering the bottoms of the beams. This kind of tile was the same that was first made in the United States of burned clay, about 1872, but they were much heavier. The first tile ever made in the United States as light as those of Roux Frères were those of the Wight Fire-

Fig. 12.



From Circular issued by Roux Frères. 1868.

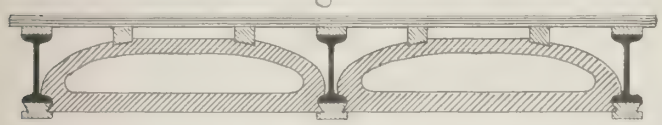
Proofing Company, made in Ohio, in 1881, for the Montauk Block at Chicago. The burned clay body was only ½ in. in thickness, yet the New Jersey manufacturers continued to make much heavier arch tiles for many years after that time.

In a circular issued by Roux Frères, in 1868, are illustrations of two other forms of flat hollow tile arches, which are shown in Figs. 11 and 12.

The first is a flat arch, very similar to that described in the

patent; but it will be noticed that the lugs and recesses at the upper corners of the tiles have already been omitted. The second is a construction in which three keys are used to form an arch, a method which has been frequently used by American contractors

Fig 13.



From drawing attached to Johnson and Kreischer Patent. Mar. 21 1871

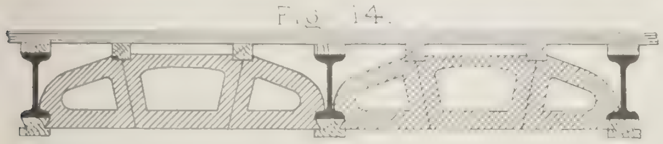
where the beams were very close together. The same circular shows many other interesting forms of hollow tiles for fire-proofing purposes.

We have now reached a point of time which is still nearly thirty years back, and find that then flat hollow tile floor arches were invented in all particulars except the use of tiles under the I beams. Naturally, there are no more records of French patents; but in the United States there was a lapse of three years before any patents appeared.

The first was that of George H. Johnson and Balthazar Kreischer, dated March 21, 1871. Fig. 13 is a copy of the drawing attached to this patent, and Fig. 14 is a copy of the drawing attached to a patent granted to Balthazar Kreischer alone on the same day, and bearing a number only four greater than that of the partnership patent.

The curious nature of this sequence of invention is obvious without explanation, and forms an illustration of some of the strange methods of inventors and what can be accomplished through the Patent Office; but the sequel shows that neither inventor ever received any benefit, unless it may have been from the sale of the patents. It

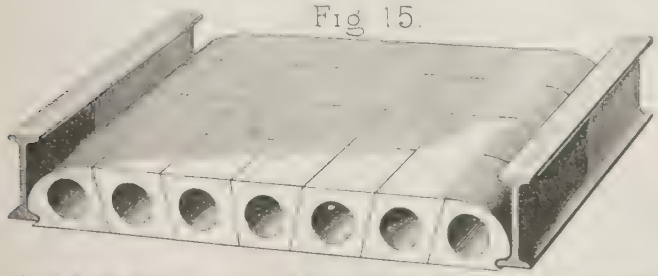
Fig 14.



From drawing attached to Balthasar Kreischer Patent. Mar 21.1871.

was evident, and the records of the Patent Office show that the form of arch in the first patent had been anticipated by the Peterson and Abord patents, and that the division of the arch tile into three parts had been anticipated by many English and French inventions. So the office recognized invention by only allowing claims in the Johnson and Kreischer patent; first, for the recesses on top to hold the wooden floor strips; and second, "The removable clay filling strips, D, in combination, etc., etc., . . . for the purpose specified," the only purpose specified in the description being "a good finish to the ceiling." The part enacted by the last claim will be referred to hereafter. The only claim allowed in the Kreischer patent was for making the arch tile in three pieces. This patent was reissued Dec. 3, 1872, with two claims substantially the same, but the number of pieces is not stated. In the drawing attached to the Kreischer patent (Fig. 14), the strips under the beams are cross-sectioned like the

Fig 15.



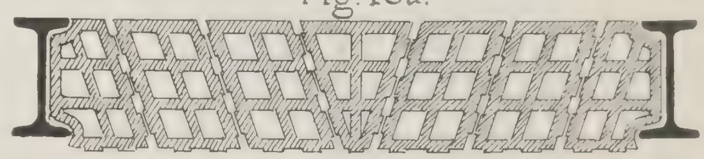
Flat Arch from circular of Heuvelman, Haven & Co N Y 1873.

floor strips, as if of wood, but are not referred to in the description or claims. When this patent was under fire eleven years later in the United States Circuit Court, these strips were always referred to as wooden strips, and this was not disputed.

Flat beam arches of hollow tile were manufactured in 1872 and 1873 in this country, and I believe that these were the first in which voussoirs of burned clay were used in America. They were employed in the floors over the outer corridors of the New York post-office, in the Kendall Building, Chicago, and in the Singer Manufacturing Company's building, at St. Louis, and a few others. Fig. 15, taken from a circular of Huvelman, Haven & Co., of New York, who were licensees under the Balthazar Kreischer patent, shows what these arches were.

About the same time flat hollow arches were made at New York by the Fire-proof Building Company of that city, which was organized to introduce French methods of construction for fire-proofing purposes in this country, the company controlling certain process patents for using cement and plaster. But they do not concern this historical review, which is intended to cover only manufactures in clay, except as throwing side lights upon constructive methods. The methods

Fig. 16a.

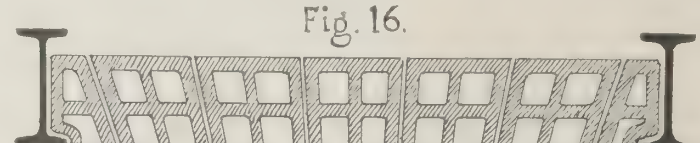


Flat Arch made by Henry Maurer. N.Y. 1875

employed in building fire-proof floors followed mainly those of Garcin and Roux, but the material was French cement, plaster, and coke breeze. These received great favor from architects at the seaboard cities, mainly on account of the confidence reposed in the scientific attainments of Leonard H. Beckwith, who was at the head of the enterprise. But at the same time the late A. H. Piequenard, architect of the new Illinois State capitol at Springfield, introduced the Garcin and Roux systems into that building, using only plaster and cinders in making the hollow blocks. These he also had seen in France, and such floor construction was used generally in the upper floors of the capitol.

The Fire-proof Building Company of New York commenced to use flat hollow arches made of burned clay in their contracts on the Coal and Iron Exchange and Tribune Buildings in that city in 1874. The avowed object at the time was that they would be better than cement in hallways and rooms which were to be finished with encaustic tile floors. The following section shows the system of

Fig. 16.



Flat Arch made by Fire Proof Building Co. N.Y. 1874

floor arch built at that time, and very similar ones are even now employed (Figs. 16, 16 a).

Flat arches of essentially the same section were soon after made and sold by other manufacturers of fire-clay goods, located in New Jersey and Staten Island, notably Henry Maurer and the Raritan Porous and Hollow Brick Company.

It was many years after the Kendall Building was constructed at Chicago before any more hollow tile arches were used in that city. About the year 1878 they were used for all the floors of the new Court House, having been manufactured in Ohio. They were made of common clay, straight at top and bottom, rather crude in form of voussoirs, and without interior webs. When the City Hall adjoining the Court House was built a few years later, hollow tile floor arches were used. They were flat on the soffit, and arched at the top, and

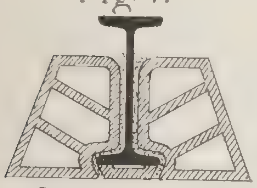
were without interior webs. These were manufactured at Utica, Ill., for the Ottawa Tile Company, now the Pioneer Fire-Proof Construction Company.

There was little or no change in the form of flat floor arches used in the seaboard States before 1885, but they were extensively employed for nearly all buildings in which iron beams were used.

In 1882, the Montauk Block was built at Chicago, being the first of the distinctively high office buildings of that city. The architects were Burnham & Root, and the writer was consulting architect up to the time that the company of which he had just become the general manager was awarded the contract for the fire-proofing. This building signalizes several departures in construction which are historic. It was the first in which iron rails were used in combination with concrete in the foundations, the account of which has heretofore been described in THE BRICKBUILDER, and the first in which the walls of an adjoining building were supported on adjusting screws during its construction and settlement. The original intention was to construct the floors of iron rails and concrete, similar to the Southern Hotel at St. Louis; but this was abandoned and 6 in. I beams were substituted in most of the floors, while 8 in. I beams were used in some parts where necessary. The spacings between the beams were consequently narrow. The floor arches used were of the section here shown (Fig. 17).

The main object sought was the least weight consistent with requisite strength. These arches weighed only 25 lbs. per superficial foot. Diagonal webs were introduced in the skew-backs, and vertical webs in the skew-backs and wide keys. The material was reduced to a thickness of half an inch. This was only possible by using great pressure. In addition to this I determined to make them of pure fire-clay. They were therefore made on a vertical sewer pipe press, and I believe that they were the first tiles ever made to demonstrate how the weight of floor arches could be reduced to the minimum, at the same time using fire-clay. Before this, the only floor arches made of fire-clay had been those for the City Hall, but the walls were all ¾ in. thick. Up to this time the weight of hollow tile floor arches had been little considered in this country, and no thought had been given to the importance of using fire-clay outside of Chicago, any refuse clay, worthless for other purposes, being considered good enough. The development of the business became rapid in the Central Western States after this, too rapid to here describe in detail. Two companies were in operation at Chicago, and their imitators soon sprung up in other localities.

Fig. 17



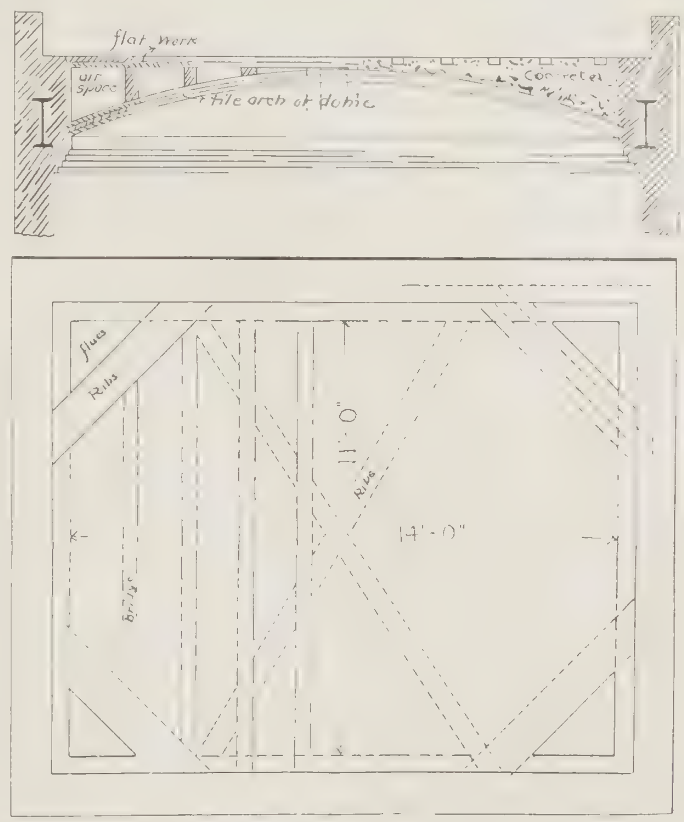
Ordinary Method of covering beams.

The next advance came in the use of porous terra-cotta for floor arches. This valuable material had been employed in Chicago for other fire-proofing purposes as long ago as 1873, and was first used in making roof blocks set between T irons at the Chicago Water Works, and for fire-proofing iron columns in the Mitchell Building at Milwaukee, and the Chicago Club Building. The first use for flat beam arches was in the roof of the old south wing of the Patent Office at Washington. As nearly as I can remember, this was about 1885 or 1886. The north wing had been burned out and restored in a fire-proof manner. Then Congress appropriated a sum to be expended in reconstructing all that part of the original building now called the south wing. The architects were Chiss & Shultz, of Washington. It was found that the whole roof of the pediment would have to be rebuilt, including the attic story and rooms in the same. There was considerable girder, column, and truss work also to be protected. On my suggestion, the architects decided to use only porous terra-cotta. The contract for the roof fell to Henry Maurer, of New York. As continuous flat ceilings were not necessary, and lightness a great desideratum, each of the beams was first covered with porous terra-cotta to about one third of its height from the bottom. Then a flat, hollow, porous terra-cotta arch was sprung from beam to beam flush with their tops, and resting on the porous terra-cotta filling on the sides of the beams. The whole was plastered and hard finished, showing the shapes of the beams.

(*To be continued.*)

A VERY interesting test was recently made of the Guastavino arch construction. The experiment was conducted at 68th Street and Avenue A, New York, and combined a fire and a weight test. A space 11 by 14 ft. was enclosed by brick walls and covered by an ordinary Guastavino vault laid with three courses of tiles, 3½ ins. thick in all, with a rise of 10 per cent. Over half of the surface of the vault there was laid a concrete filling to a height of 2 ins. above the crown, while the haunches over the other half were built up with ribs or bridges connected by two level courses of tiles, leaving hollow spaces as indicated by the diagram. This was to ascertain whether one construction would be more affected by heat than the other. A fire was built in the chamber under the vault, the gases being carried off through flues at the corners of the rectangle.

The resulting temperature in the combustion chamber varied from 2,000 to 2,500 degs., rising sometimes as high as 2,525 degs. During this time there was a fixed load of 150 lbs. per superficial foot upon the arch. The closest observation did not indicate any deflection due to the load before the fire. During the test the ceiling and the walls rose by expansion one half an inch, and the crown of the vault of one fourth of an inch more. After being exposed to the heat



for five hours, water was thrown on the vault from below, and the fire put out. Through the action of the sudden lowering of temperature when the water was applied, the templet course fell in a few places. When the vault was cooler the deflection of the ceiling was only .22 of an inch, but when the load was removed the vault rose again so the deflection was only .17 of an inch. After this, the load was again applied, and increased until 600 lbs. per superficial foot, something over 50 tons in all, was imposed. The operation of loading took some six hours, during which time the ceiling gradually deflected in the crown to a total deflection of .37 of an inch, remaining in that position thereafter.

The load and the fire were much more severe in this than in any previous test, especially the loading after the fire. There was no perceptible difference in the behavior of the two methods of construction above the vault.

Mortar and Concrete.

AMERICAN CEMENT.

BY URIAH CUMMINGS.

CHAPTER VII.

CEMENT TESTING.

(*Continuation of tests made by Prof. Cecil B. Smith.*)

ALTHOUGH the utilization of natural cement rock for Portland purposes is not practised to any great extent in Europe, owing, no doubt, to the uneven quality of such rocks, yet in this country more than two thirds of the Portland cement produced is from this source.

Limestone to the extent of 10 to 15 per cent. is added to the cement rock, which, in the section where such Portlands are manufactured, contains an excess of clay.

Portland cements produced in this manner are fully equal in quality to those which are compounded by an artificial admixture of clay and carbonate of lime, and it may be said, in passing, that there are no Portland cements in the world superior to those produced in this country.

The consumer who uses imported brands in preference does so at his own risk, for no manufacturer in Europe guarantees the quality of his cement after it is delivered into this country. The Portland producers here guarantee their product, as do the rock cement manufacturers, and they are here on the ground ready at all times to make good any damage which may be caused by the failure of their cements.

And yet, at the present time, there are three barrels of imported Portland used in this country to one of our home production. Such is prejudice. Still, it is pleasant to note that it is gradually dying out, and it is to be hoped that the time is not far distant when American Portlands will be used in preference to those from other countries.

If we take a few pounds of correctly proportioned cement rock in one piece, and divide it into two equal parts, and designate them as samples No. 1 and No. 2, and take No. 1 and calcine it, and then grind it to powder, we have converted it into a natural hydraulic cement.

If we take sample No. 2 and first grind it to powder, and then calcine it, and again reduce it to powder, we have converted it into a Portland cement. This comprises all the difference in the manufacture of the rock and Portland cements.

Now if we mold these samples separately into briquettes and submit them to a tensile strain test per square inch of cross section, treating them alike as to time in air and in water, it is probable that when tabulated they would appear about as shown in the following table, provided, of course, that both samples had been calcined in accordance with the methods now in vogue by the manufacturers of each class.

TABLE A.

Time.	Lbs. 1 Day.	Lbs. 1 Week.	Lbs. 1 Month.	Lbs. 6 Months.	Lbs. 1 Year.
No. 1	65	175	175	350	500
No. 2	125	400	500	750	1,000

Granting that this table is approximately correct, and we have a large collection of tables gathered from many sources which substantially verify the figures given, what are the conclusions to be drawn therefrom?

If the actual values are to be measured by the pounds in tensile strength which the briquettes are capable of sustaining, and this is the prevailing belief at the present time, and has prevailed during the past thirty-five years, it would seem indisputable that up to one year No. 1 had but one half the value of No. 2.

It is safe to assert that not one engineer or architect in a thousand carries his tests beyond one year.

It is equally safe to assert that not one in a hundred carry tests beyond three months.

It is not difficult then to understand, in the light of the table given, how the prevailing opinion became so firmly established.

The idea that the higher the test the greater the value has come to be firmly fixed in the public opinion as being sound beyond question.

The manufacturer whose cement tests higher than that of his neighbor in a one or thirty day test, wears an air of superiority which is simply indescribable.

It is settled in his mind that his cement is better than that of his neighbor.

And the neighbor who is defeated in the test is correspondingly depressed. He has a feeling akin to that of the speculator in Buffalo, N. Y., who walked across the road to bestow a kick on a certain sleeping omniverous mammal lying in the gutter, because pork had taken a drop in the market that day.

And well may the defeated cement maker feel somewhat depressed, for the chances are ten to one that the engineer who made the tests believes the higher testing brand the better of the two.

It does not follow that the lower testing cement is the better, although it is not impossible, by any means. Neither does it follow that the same results would obtain had some other engineer tested the same brands from the same packages.

But in the table we have another problem to deal with. Here the two classes are made from identically the same material, and the differences in the testing can only be attributable to the different modes of manufacture.

The Portland cement has set much more rapidly than the other during the first year, and it is this fact alone that has brought almost, if not quite, all the cement-making and cement-using world to believe that Portland cement is vastly superior to the rock cement.

The question arises as to whether or not the prevailing opinion is founded on fact. If the answer is confined to the one year's showing, then it must be said that the opinion is sound.

But if the public could be brought to realize that one year is but the beginning of the test, that the real trial is but fairly started, and is on, so long as the work endures, in which the cement is used; if it were understood that after five years not one engineer in a hundred can tell either by simply looking at a wall laid in cement, or by the use of the hammer, whether the cement used was rock or Portland cement, and if it were known that it is a fact, that when we have occasion to blast out old concrete laid in rock cement twenty-five years before, we find it as hard as any rock; and if it were possible for the public to become as familiar with three to five year tests as they are with the prevailing tests, then there would be a remarkable overturning of preconceived notions in regard to cement values, and thinking men to undertake a readjustment of their opinions, for nothing is more certain than that if the samples Nos. 1 and 2 of the table given were carried along in the tests yearly from one year to five, the table A continued, would appear substantially as follows:—

TABLE B.

Time.	2 Years.	3 Years.	4 Years.	5 Years.
No. 1	700	800	900	1,000
No. 2	1,000	800	750	600

The following table of tests was made by C. E. Richards, cement tester on the new Croton Aqueduct at Brewster, N. Y., from American rock cement manufactured by the author.

Briquettes one square inch in cross section, one hour in air, balance of time in water.

No. of Briquette.	Time when Made.	Time when Broken.	Tensile Strength lbs.
1	Oct. 4, 1886.	Nov. 18, 1889.	910
2	Oct. 11, 1886.	Nov. 18, 1889.	860
3	Oct. 11, 1886.	Nov. 18, 1889.	960
4	Nov. 29, 1886.	Nov. 18, 1889.	960
5	Nov. 21, 1886.	Unbroken at 1,000 pounds.	
6	Nov. 30, 1886.	Unbroken at 1,000 pounds.	

The Riehlé 1,000 pound testing machine used.

The following is an extract from "Records of Tests of Cement," made for the Boston Main Drainage Works, 1878–1884, by Eliot C. Clarke, M. Am. Soc. C. E., page 160: —

"The following series of tests may be of interest on account of the age of the specimens. The mortars were made with an English Portland cement, both unsifted as taken from the cask, and also after it had been sifted through the No. 120 sieve, by which process about 35 per cent. of coarse particles were eliminated.

TABLE NO. 12.

BRIQUETTES I SQUARE INCH CROSS SECTION.

Kind of Cement.	Neat Cement.		Cement 1. Sand 2.		Cement 1. Sand 5.	
	2 Years.	4 Years.	2 Years.	4 Years.	2 Years.	4 Years.
Ordinary cement unsifted.	603	387	339	493	182	202
Cement which passed No. 120 sieve.	374	211	478	580	250	284

"This table also shows that fine cements do not give as high results, tested neat, as do cements containing coarse particles, even coarse particles of sand. It also shows (what is often noticed) that neat cements become brittle with age, and are apt to fly into pieces under comparatively light loads."

It cannot be denied that at five years artificial cements are extremely brittle, and briquettes made from this class of cements, if let fall on a stone floor, after they are four or five years old, will fly into as many pieces as would a glass bottle falling from the same height, and this is not true of the better quality of rock cements.

But engineers tell us that they cannot wait five years, or five months even, to learn whether a cement is good or bad, which is true enough, but does not alter the facts in the case; and the facts are that very high short-time tests are unfailing evidences of subsequent weakness.

These facts are demonstrated in every table wherein the tests have been carried from one day to five years, that has ever come under the observation of the author.

The following is an extract from a lecture delivered by the author before the Society of Arts of the Massachusetts Institute of Technology, Boston, November, 1887: —

"The testing machine reveals many curious freaks, and taken on the principle that "everything is for the best," it may yet reveal to us that a cement may test too high, that this modern demand for high testing cement, and the tremendous struggle on the part of the Portland cement manufacturers to supply it, striving by every conceivable means to beat the record, is all wrong.

"This may sound strangely at first, but a study of the tables of long-time tests of Portland cements, as compiled by such engineers as Clarke, of Boston, and MacClay, of New York, and others eminent in the profession, reveals the rather startling fact that briquettes of neat Portland do not test as high at three or four years as they do at one or two years old. Clarke says: —

"'They become brittle with age and are apt to fly into pieces under comparatively light loads.'

"If this is the result with neat cement at that age, what is to prevent the same results with sand mixtures at fifteen to twenty years or so?

"The ten years' tests of Portland cement, made by Dr. Michaelis, of Berlin, show that the maximum strength was reached at the end of two years, and this point held fairly well until the end of the seventh year; but from that time until the end of the tenth year there was a remarkable falling off in values. We do not recollect ever having seen any table of long-time tests of Portland cement that did not exhibit similar results, and it is more than probable that it may yet be shown that our best natural, slow-setting American cements may, in ten to twelve years' tests, surpass any artificial cements. The excellent condition of some of our old work, done many years ago with American cements, would seem to indicate as much.

"At all events, we have no proof that the Portland is superior in the matter of durability, and we do not believe that clay and lime can be suddenly thrown together, and kept there by any skill of man, that can, in any manner, compare with the staying qualities as found in first-class natural cements, where the clay and lime have existed in the most intimate contact for countless ages."

It is now over nine years since the foregoing was written, and in the meantime the only changes in the views of the author on this subject have been to strengthen rather than to weaken the proposition then advanced.

Years of close observation as to the changes constantly occurring in a cement subsequent to its use in masonry or concrete leads to the inevitable conclusion that a cement which hardens too rapidly in its early stages, whether it may be a natural rock or an artificial cement, should be looked upon with suspicion rather than with approval.

It is patent to every observer who has had occasion to examine briquettes made from both classes, and broken at three to five years, that those which by the records are shown to have tested high in their early stages are at a later period extremely brittle and glassy, and are entirely devoid of that peculiar toughness which characterizes the slower setting varieties.

A cement which attains its limit of tensile strength rapidly will, the moment that limit is reached, commence to become brittle, and from that time on there will be a continual loss in cohesive strength in direct ratio with its increasing brittleness.

Brittleness and weakness are synonymous.

Mr. C. H. Brinsmaid, city cement inspector, City Engineer Department, Minneapolis, Minn., has had twelve years' experience in cement testing in the department named, and has compiled some valuable tables of tests, some brands of Portland running as high as nine years.

In a correspondence with the author, he remarks incidentally: — "Lacking experience, nothing would surprise me more than to see how very brittle these old Portland samples become, and how they snap and fly into fragments by a blow of trowel or hammer. There is no question but that old Portlands are more brittle than rock cements of the same age, however difficult it may be to note the proper comparison."

In Mr. Brinsmaid's tables of neat Portland tests, the figures disclose that three of the leading German and five of the English Portlands reach their limit of strength at one year, after which time they begin to deteriorate, at seven years the German falling to 476 lbs., and the English to 592 lbs.

Referring to the table (A) continued, it is pertinent to repeat the question, "What are the conclusions to be drawn?"

Both No. 1 and No. 2 are produced from identically the same materials and in the same proportions, but No. 1 being a solid rock, and No. 2 a porous mass, they are not affected equally by the same amount of heat, and it is from this cause alone that one hardens much more rapidly than the other, and consequently tests higher in its early stages. But that is no evidence of superiority, notwithstanding public opinion to the contrary.

There are certain classes of work wherein it may be necessary to use the higher testing varieties, such, for example, as sidewalks and similar work, but for heavy foundations and massive masonry, to use

the higher priced cement, simply because it tests higher in short time tests, is expensive folly, for the slower setting variety, or, in other words, the natural rock cements, have been successfully used in the heaviest masonry in the world.

It is well understood that the process of hardening of a cement is simply the crystallization of the silicates, which commences shortly after they have become hydrated by the application of water. Some hydrated silicates crystallize much more rapidly than others.

Rapid crystallization means imperfect crystallization, uneven in size, shape, and texture. In fact, a mere jumble of irregular crystals, and the very rapidity of their formation insures subsequent brittleness and weakness, while those silicates which crystallize slowly form crystals perfect in shape, size, and texture.

Dana, in his "Manual of Geology," page 627, in speaking of the texture of rocks, says: "The grains are coarser the slower the crystallization, or, in other words, the slower the rate of cooling during crystallization; and with rapid cooling, they sometimes disappear altogether, and the material comes out glass instead of stone."

So in the crystallization of the silicates in a cement. If it tests high in its early stages, the breakings of the briquettes disclose the glassy texture, which is quite unlike the stone-like texture exhibited in the slower varieties.

It is possible, then, that the testing machine may yet be the means of convincing the public that a cement may test too high, as stated in the quotation of nine years ago.

The author does not consider it wild or extravagant to assert it as his deliberate opinion that the specifications drawn by the engineer of the future will stipulate that the cement to be used shall not exceed nor fall below a given number of pounds in tensile strength per square inch in cross section at one, seven, thirty, and ninety days.

When that day arrives there will cease this unseemly scramble for high short-time tests. Reason and common sense will prevail, guided by a practical knowledge of the chemistry of cements.

It is not the purpose of the author to disparage or discredit Portland cements, but rather to point out their defects, in the hope that in so doing, more consideration may be given to the subject, and juster conclusions reached.

Unquestionably an ideal hydraulic cement can be produced by what is known as the Portland process, and there is but little doubt it would have been much in use at the present time, had it not been for the unfortunate misinterpretation of the readings of the tensile strain-testing machine in the early stages of its existence.

At the time of its first introduction into England, Portland cements were selling at one shilling per bushel, and rock cements were selling at eighteen pence per bushel.

Such was the public opinion as to the relative values of the two classes of cements sixty-two years after Parker had brought out his Roman (rock) cement, and thirty-four years after Aspdin had produced his artificial (Portland) cement.

Even at the difference in prices, the Roman cement had by far the larger share of the market, and the only means of ascertaining the relative values was by the behavior of the cements in actual work, and making such tests as placing balls of the cement under water.

Then came the tensile strain-testing machine, and it was soon ascertained that the Portland brands tested higher than the Roman cements.

It must have been an important event, an epoch, in fact, in the lives of those engineers, to be confronted with the revelations disclosed by the testing machine.

They had been using both classes of cements, and the rock cements stood, if the price is any criterion, 50 per cent. higher in their estimation than the Portland cements. And yet the testing machine showed them that the Portland cements were the stronger, and so, they reasoned, that if stronger, they must be better. Therefore they had been laboring under a hallucination for, lo, these many years.

Judging by their experience in the use of both classes, the cement which had seemed to them to be the best, that had given them the least trouble, was not the best, after all.

They never questioned the soundness, or rather unsoundness, of their new-found scheme for determining values.

It did not occur to them that the higher testing cement was not necessarily the better cement, and they accepted the result as indisputable.

With their former teachings and experience on the one hand, and the testing machine on the other, the question was not long in doubt. The machine was victorious, and thenceforward all judgment founded on experience was laid aside, and they became blind believers in the tensile strain tests.

What matter though they were continually befogged by the frequent, unreasonable, and capricious pranks of the machine, they had found a god, and were determined to worship it.

And so it came to be established as a fixed belief among engineers and architects that the best cement was the one which tested the highest, and the manufacturer had no alternative but to strive to make his product test as high as possible.

The next step was in the direction of forcing higher tests by using an excess of carbonate of lime, or by adulterations.

(*To be continued.*)

LIME, HYDRAULIC CEMENT, MORTAR, AND CONCRETE. II.

BY CLIFFORD RICHARDSON.

CHARACTERISTICS OF GOOD LIME.

PURE calcium oxide consists of 71.4 per cent. of calcium and 28.6 per cent. of oxygen. Its ordinary form is that of a more or less porous earthy white solid which, in a pure condition, is very resistant to heat. It has, as has been shown, a great affinity for moisture and must be preserved out of contact with air from which it absorbs water and carbonic acid.

Caustic lime, for building purposes, should have the following properties: —

Except when made from coarsely crystalline marble, or from marl or shells, it should be in hard lumps.

It should be white, or nearly so, in color. Lime of a yellow or brownish color, with veins of silicious matter, is inferior.

It should be free from semi-fused or fused stone, showing overburning, and from unburnt ash of fuel or clinker.

It should contain less than 10 per cent. of impurities, but often has more.

It should slake rapidly, showing that it is rich and fresh.

Good lime in lumps should weigh, as packed, with about 40 per cent. of voids, 60 lbs. to the cubic foot, 75 lbs. to the bushel, and from 220 to 230 lbs. to the barrel of 3 bushels. If ground or in powder it will weigh less when packed loosely, but when well shaken down it will weigh as much as 270 lbs. to the barrel. A lump of hard lime, 1 ft. cube, would weigh about 95 lbs., having a density of 1.52.

THE SLAKING OF LIME.

Caustic lime combines with water with the evolution of heat to form calcium hydrate. Every 100 parts of caustic lime require 32 parts of water for its conversion into hydrate. If one third of its weight of water is sprinkled on quicklime it becomes very much heated, cracks open, if of the massive variety, swells up and falls to powder. The heat developed is sufficient, at times, to ignite wood. The quicklime becomes slaked lime. This consists of 75.7 per cent. of calcium oxide and 24.3 per cent. of water. It has a specific gravity, when pure, of 2.07. The increase of volume in the process of slaking is due to the formation of steam, which tears the particles of lime apart and expands the mass. If a current of dry steam is passed over heated caustic lime confined in a tube it becomes slaked without any increase of volume.

The smaller the amount of impurities the more energetic is the

act of slaking and the greater the increase of volume. In rich and pure limes the increase of volume under ordinary conditions will be over twice that of the unslaked material, including the voids, while with very poor limes it may be much less. The statement frequently made that lime increases three volumes in slaking is based upon the increase in volume due to the excess of water often used in slaking. In this case it may be as great as 3.4. The amount of increase of volume for the same lime may be very variable, depending on the conditions under which it is slaked. We have seen that it is a reaction between water and caustic lime where much heat is generated, and that to the steam evolved is largely due the expansion of the lime. It is evident, therefore, that the provisions for augmenting and retaining this heat are of importance. If water is added slowly but comparatively little heat is developed, while slaking in an open space will not give as much as when it occurs in a closed box. Cold water also will not accelerate the action as well as warm. The amount of water used has a marked effect on the volume of slaked lime produced. With an equal volume of water the increase for a good, rich lime is from 2 to 2.4. An increase or reduction in the amount of water or in the volume weight of the lime may increase or diminish this.

The following experiment shows the effect of different amounts of water on an ordinary lime.

Volume of Water.	Increase.
½	1.6
1	2.0
2½	2.5
With a poor dolomitic lime the volume increase was only	
2	1.7

It appears, therefore, that the increase of volume to be expected of any lime is dependent on conditions which may be very variable. For example, a peck of lump lime with 44 per cent. of voids between the lumps gave, on slaking with its own volume of water, 2¼ pecks of fine powder of slaked lime, which is a fair increase in volume for lump lime. From 1 peck of closely packed lime, however, 2.5 volumes of slaked lime were obtained. The difference in volume is of course due to the difference in weight of the lime as packed in the two ways.

The proper comparison, therefore, is one of volume from weight. 10 lbs. of caustic lime, for instance, should give 6.8 bushels of slaked lime, an increase of volume of 2.25. Gilmore found in some of his experiments increases as great as 2.46, 2.83, 3.21, 2.40, and 2.14, but the weight of lime in his unit volumes was much greater than occurs in practise, and large amounts of water were used in slaking so that he was dealing with paste instead of dry slaked lime. His experimental results, as compared with our own, are as follows:—

	Rockland. Gilmore.	Roundout. Gilmore.	New York. Richardson.
Weight of lime in lbs.	5	5	5
Volume of lime in c. c.	1557	1806	2350
Volume of water to slake	2983	3300	2000
Increase of weight, per cent.	2.24	2.24	1.60
Increase in volume	2.46	2.14	1.91

It will be seen that 5 lbs. of Gilmore's lime occupied a smaller original volume than ours, and an excess of water was used in slaking, which accounts for his results. The theoretical increase in weight should be 1.53 per cent.

General Totten found in experiments on slaking limes no increase in volume greater than 2.27 when no more than an equal volume of water was used. The increase of volume is commonly used as a test of the quality of lime.

Air Slaking. Slaked lime is also produced by exposure of caustic lime to the air, from which it absorbs sufficient water to become hydrated, as well as some carbonic acid. This is known as air-slaked lime. It is of little value for mortar making, because there has not been enough heat produced in its formation to tear apart and expand the particles which will alone enable it to form a rich paste. The larger particles have also to a certain extent become hardened on their surfaces by a kind of setting, and by the absorption of carbonic acid from the air.

Practise in Lime Slaking. In practise, the slaking of lime for mortar is conducted in several ways. Either sufficient water is sprinkled over the lime to combine with it and resolve it to a powder, providing also an excess for that lost in the form of steam, or an excess is added at once, sufficient to make the finished mortar.

The first method is in some ways the best, because a finer, looser powder is produced, in the manner already described, and because the poorer limes are much more easily and thoroughly slaked in this way with the aid of the greater heat evolved. When too large an amount of water is used the development of heat is prevented, and the operation is much less complete. The particles of lime which are left unslaked go into the mortar in that condition and, being subsequently slowly hydrated by the moisture of the air, expand with injurious effect after it has been used. The popping of mortar, frequently noticed in the walls and ceilings of dwellings, is due to this cause. For the same reason, given above, all the water which is to be used should be added at once or nearly so. If it is added in small portions the effect is to cool down the whole mass and prevent thorough slaking.

We have seen that a third of its weight of water is theoretically necessary for slaking lime. In practise, however, to allow for vaporization as steam, and for the slight excess necessary to bring all the particles in contact with moisture, this amount must be increased to at least an equal weight. It is difficult to say what volume of water should be used, as this depends on the volume weight of the lime, which is variable. It is ordinarily about that of the lime itself plus its voids. Practically it is convenient with fat lime to use two and a half volumes of water, which will suffice for slaking and for the production of a paste. Poor magnesian limes require less.

As heat assists in the expansion of the lime, the operation is best carried on in a covered box. One half of the water is added at first, and as soon as the lime begins to fall to pieces the rest is poured in and thoroughly mixed with the slaking material. The entire mass will thus be raised to a high temperature. The operation thus carried on takes place rapidly, but it can hardly be considered completed until the mass has become cool, or until even after a longer time. In cold weather it is advantageous to use warm water, especially with poor limes.

Water for Slaking and Mixing. Water used for slaking lime and making mortar should be pure. When it contains salts, such as chlorides and sulphates, the mortar effloresces and gives rise to stains. For this reason sea water is unsuitable, although it has been used successfully with hydraulic cement.

LIME PASTE OR CREAM.

The lime paste made in the manner previously described may be too stiff for mortar if a very rich lime has been used, or if a very large volume of sand is to be employed in making the mortar. There is no difficulty in thinning it, however, to the proper consistency, depending on the character of the mortar to be made. If, however, more than two and a half volumes of water are added to the lime at first the resulting paste will have a tendency to be granular and to contain lumps which, in the thin cream, it is impossible to break up. In careless practise as much as three or four volumes of water are sometimes used in slaking lime, when it is intended to make a mortar with a large volume of sand. Stretching the cream in this manner to make a small amount of lime fill a large volume of sand voids makes the resulting mortar very porous when dry.

Good paste of lime should not contain at the extreme more than three volumes of water as compared to the measured volume of the quicklime.

As there are generally some hard and unslaked particles even in the best limes, the cream should be run through a sieve if possible, after standing over night, before mixing it with the sand. It should be remembered that the longer the paste stands before use the smoother it becomes. As will be seen later, this improvement goes on after the mortar has been mixed.

The Masons' Department.

THE ARCHITECT AND CONTRACTOR.—(*Continued.*)

BY THOMAS A. FOX.

THE LOWEST BIDDER.

THE recent controversy between the mayor of Boston and the Master Builders' Association of the same city, regarding the award of the contract for building a public bath house, although carried so far as to become merely a war of words, has nevertheless raised several questions of importance to all persons interested directly or indirectly in the building business. The simple facts of the case are as follows: The city advertised for bids on a bath house, and the contract for the work stated that preference would be given to "union labor." The bids were opened and taken under advisement, as is customary, but after the usual time allowed for the examination of the proposals had elapsed, instead of awarding the contract to the lowest bidder, it was given to the second lowest, whose figure was some three hundred dollars higher. This action at once aroused the indignation of the Master Builders' Association, one of whose missions is to guard the interests of the lowest bidder, providing his qualifications for the performance of the work are unquestioned, and the mayor was at once asked to explain the reasons for such discrimination. The reply was made that as the labor unions had taken special interest in this particular scheme, it was thought desirable to have, so far as possible, only union labor employed on the work, and that the contract had been awarded to the concern which was known to employ this class of help. Subsequent correspondence, however, brought out the fact that the lowest bidders employed union labor as well as those who had received the award, and the mayor's action in the end seemed to be justified only by the right which is always reserved to reject any or all bids, should it be for the interest of the city so to do, which doubtless justified the transaction from the legal, but not necessarily from the moral point of view. As almost all of the labor unions of the city have since passed resolutions indorsing the mayor's action, the motive in this particular instance seems to be apparent. Although the incident in itself is of no great importance, there are several principles involved which justify a brief consideration. First, as to the advisability of awarding public work to any but the lowest bidder, providing he is responsible. While in many instances it would undoubtedly be for the interest, both of the public and the architect, to discriminate in the awarding of such work, nevertheless, where contracts are thrown open to general competition, as is usually required by law, it is establishing a dangerous precedent to permit the work to be given to any but the lowest bidder, unless he may be proved irresponsible, and the amount of difference between the bids should have no bearing whatsoever in the case, as it was intimated was the fact in the instance above noted. The difference of a dollar, under these conditions, should be respected just as much as a difference of a thousand or more.

If discrimination in the award of contracts for public work is to be permitted at all, it should be done by allowing the architect, or other qualified person or persons, to select a certain limited number of contractors to figure the work, thus preventing the work being placed upon the open market, and the consequent liability of being obliged to accept an inferior grade of work; but where this method is employed the rights of the lowest bidder should always be respected, as well as under an open competition.

The award of this bath-house contract, moreover, shows the labor unions in rather a new rôle. It is true they have for some time been asking for various forms of legislation in their behalf, and have appeared in politics to a considerable extent, but this is one of the first instances where they have requested or gained favoritism in the award of a building contract. But this step is only following some of the numerous examples which we have constantly before us, in the direction of asking the government to do something for somebody for no valid or particular reason, a policy which, if not checked and rooted out, will soon prove, if it is not already, a serious menace to our republican institutions. There is no ground on which a labor union can ask for preference in the awarding of contracts for public work, unless it may be for the same reason that such organizations as our largest trust and most extensive monopoly receive aid from the native government, which is, of course, no reason at all, and the sooner such things are stopped the better. The evils of special legislation and class preference are in direct antagonism to the spirit of republican institutions, and admit of no argument. The example in such directions is set by those who ought to know better, but whose avarice and greed overcome their rather shallow ideas of justice and honesty. Who can wonder that such example is blindly followed by those who see the government being used to bolster and enrich private individuals and corporations, and from this spectacle gather the impression which soon becomes conviction, that legislation is the panacea for all ills?

It was intimated during the controversy regarding the award of this contract, that one of the reasons for giving a preference to union labor was that it would insure better work, which is at best a most doubtful statement, for the simple reason that most unions are run to help the poorest rather than the best men, a principle which, being in direct violation of one of the fundamental laws of nature, namely, "the survival of the fittest," is bound in the end to fail. The truth is that the management of the great majority of unions is in the hands of incompetent men, those who like to talk but not to work, and very often a man who is too poor a workman to earn a day's wages at his trade is found high up in the councils of the union, or an active member of the board of walking delegates. It is certainly a fact that at the present time union labor insures no better work than the average, and there is consequently no just reason for discrimination in their favor under the impression that superior results will be thereby obtained. No one who has followed the work of the labor organizations can deny that in many ways their work has been beneficial and progressive but in this matter they have shown as they too often do their weakest side. The award of the contract for this building and the controversy which followed it have certainly raised several novel questions, and it will be interesting for all those who are concerned in such matters to watch the future developments, for the affair has raised several interesting points which will take time and further experience to decide.

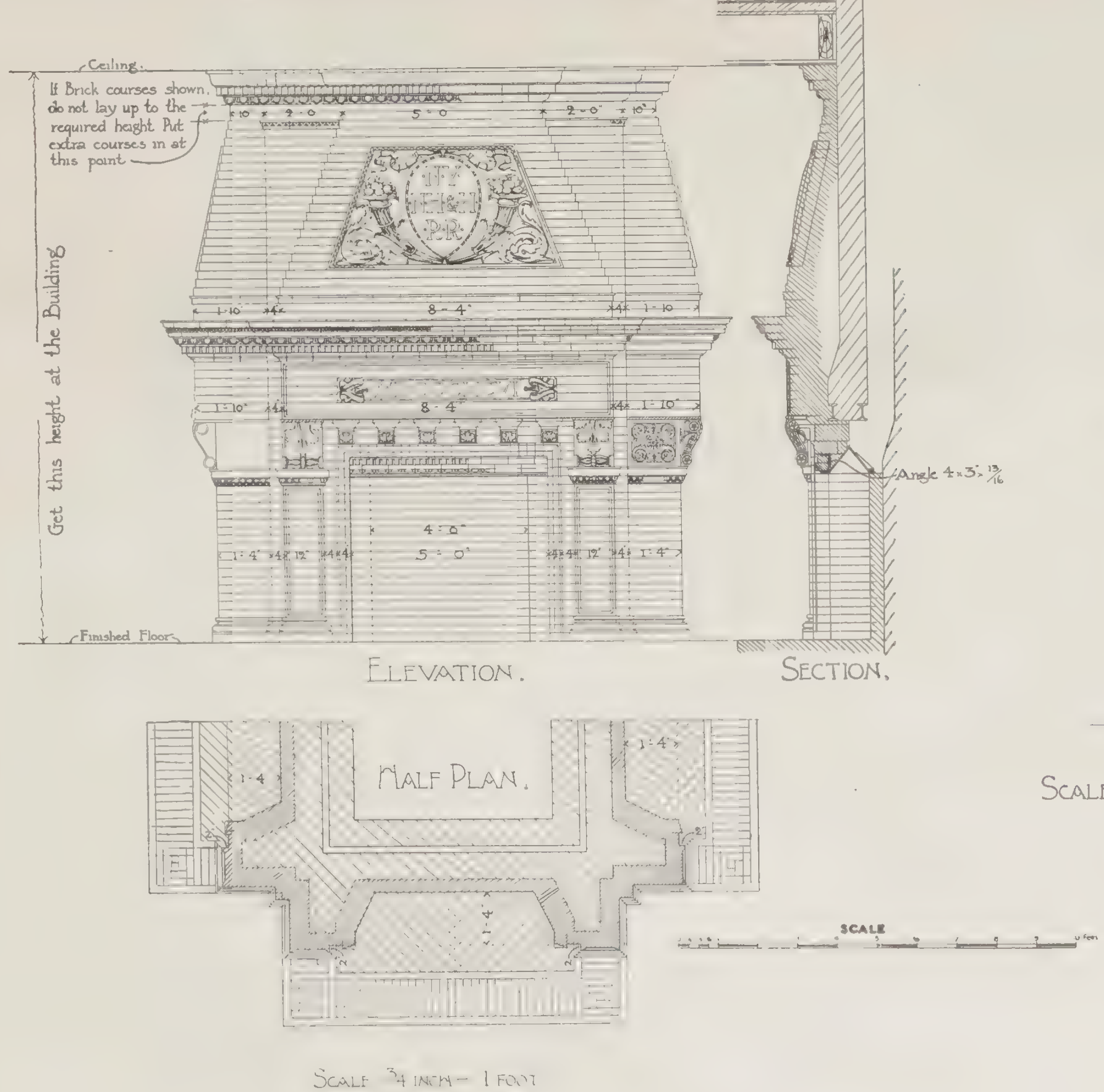
HEIGHT OF FACTORY CHIMNEYS.

THE notion that the greater the height of a chimney for a boiler plant the greater will be its draught-producing power is responsible for the existence of many chimneys of imposing size, and, at the same time, unnecessary expense. A very tall chimney, well proportioned and gracefully outlined, may be a striking architectural adjunct to a factory, but it is also one that costs considerable money without doing any measurable amount of good. Where chimneys are intended to carry off noxious fumes from chemical works, there is, of course, some method in providing for unusual height, since the aim in such a case is to insure as complete as possible a diffusion of the vapors and prevent their mingling with the air of the lower strata; but for boilers simply unusual height, as stated, is rarely based upon a good reason.

As a matter of fact, the draught-producing capacities of chimneys having flues of the same size are in proportion to the square roots of their heights, so that if one were to have double the power, if it may be so called, of the other, it would have to be four times as high, and not merely twice as high, as many would suppose. A height of 150 feet may be considered, on good authority, as the maximum necessary in any case for producing the requisite draught, providing, of course, that the area of the flue has been properly proportioned. This latter should be made to bear a pretty nearly direct ratio to the combined areas of the boiler flues connecting with it. A chimney much beyond 150 feet is generally suggestive of misspent money.—*Cassier's Magazine for August.*

MANTELS IN THE RESTAURANT OF PASSENGER STATION. PROVIDENCE. R. I. FOR THE NEW YORK. NEW HAVEN AND HARTFORD RAILROAD

200



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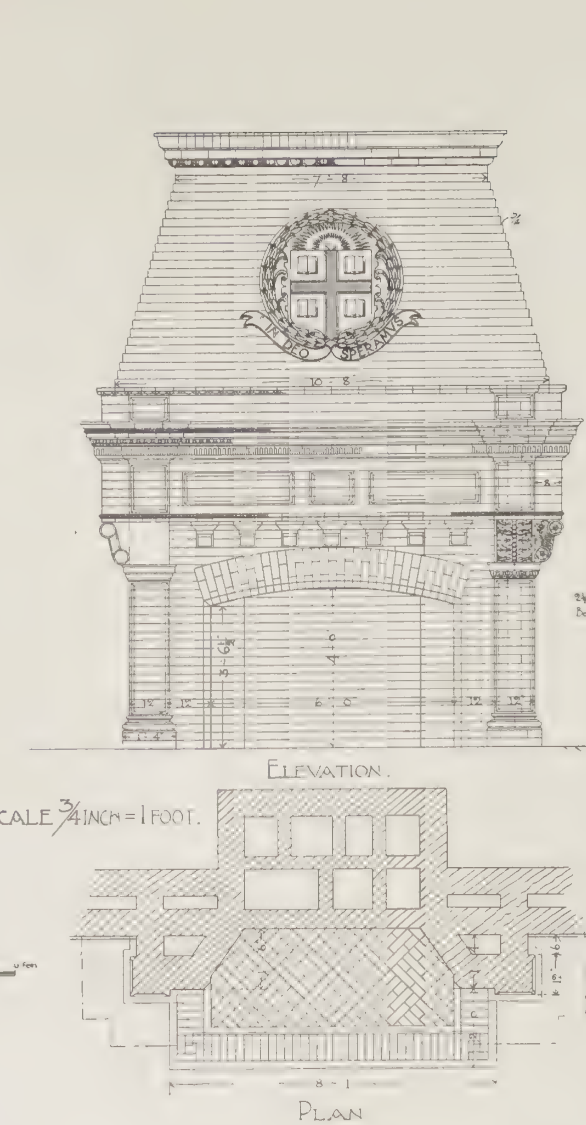


SCALE 3/4 INCH = 1 FOOT.

DETAILS OF BRICK MANTELS IN THE THIRD STORY OF THE RECITATION HALL WOMENS COLLEGE BROWN UNIVERSITY
November 17 1896

STONE CARPENTER AND WILLSON.
ARCHITECTS
49 Westminster St Providence R. I.

Recent Brick and Terra-Cotta Work in American Cities, and Manufacturers' Department.

NEW YORK.— During the past month there has been a decrease in the number of plans for large and important buildings which have been filed with the building department, but there has been a decided increase in the number of contemplated dwellings and apartment houses, both city and suburban. This is the best possible indication of gradually restored confidence and the passing of "hard times." Business men will risk a great deal of money at almost any time when a large return seems assured to them, but the luxury of a new dwelling house cannot be indulged in when the future is uncertain. One unfortunate instance of misplaced confidence has been brought to our notice this week in the Syndicate Building, sold for the third time within two years, and at a great loss to its original owners, injured to a great extent by its name.

A very interesting new building is the Telephone Building, on Dey Street, just completed. It has a very refined Italian Renaissance façade, constructed entirely of blocks of terra-cotta, with a great deal of elaborate detail beautifully executed. This building is so successful that a great many are of the opinion that terra-cotta will be largely used in place of stone for facing in the future.

Great changes will be made this month on lower Broadway to make room for the many new office buildings, as announced in our last number. Many old landmarks will have to go; one particularly

TERRA-COTTA FRIEZE, ENTRANCE TO STANDARD BUILDING, CLEVELAND, OHIO.
Made by Northwestern Terra-Cotta Company.

interesting, as it is the last residence remaining on Broadway in what was once a fashionable section, the handsome building corner of 19th Street, known for generations as the Geolet Mansion. It will be destroyed to make way for an eight-story brick store and loft building, to be erected by Almy & Gallatin, from plans by J. B. Snook & Sons, architects.

ST. CHRISTOPHER'S HOSPITAL, FAIRHILL SQUARE, PHILADELPHIA, PA.
Frank Miles Day & Brother, Architects.

Another sky-scraper is to be erected overlooking Battery Park. R. A. and W. H. Cheseborough have filed plans for a fifteen-story brick office building, to cost $200,000. To be erected from plans by Clinton & Russell, at the southeast corner of State and Pearl Streets, opposite the present six-story Cheseborough Building.

J. C. Lyons has filed plans for a twelve-story brick store and loft building, to cost $800,000, to be erected at Nos. 294 and 296 Broadway, extending to Manhattan Place. Buchman & Diesler are the architects. This building will adjoin the fifteen-story R. G. Dun Building, for which excavations are now in progress, while the Astor estate will build to the north at the Duane Street corner.

Barney & Chapman, architects, have designed a sixteen-story office building, to be erected at 684 Broadway, for the Rhinelander estate.

Harding & Gooch have filed plans for an eighteen-story hotel, to be erected on the Paran Stevens property, 44th Street and Fifth Avenue, at a cost of $1,500,000.

Wm. Rankin has filed plans for four five-story brick stores and flats, costing $100,000, to be erected at the southwest corner of Manhattan Avenue and 102d Street.

The city has filed plans for a five-story brick public school building, to be erected on the east side of Avenue A, between 77th and 78th Streets, at a cost of $260,000.

The trustees of the Cathedral of St. John

OFFICES OF THE NEWARK GAS COMPANY, BROAD ST., NEWARK, N. J.
Henry J. Hardenbergh, Architect.
Front brick furnished by Raritan Hollow & Porous Brick Company.

the Divine ave decided to complete the choir at once; $1,000,000 has been appropriated for this purpose. A bishop's palace is to be commenced as soon as the plans are approved, which will cost $100,000.

KEYS TO FIFTH-STORY APARTMENT HOTEL, 83D STREET AND RIVERSIDE DRIVE, N. Y.
James R. Ware, Architect.
Executed in terra-cotta by the Excelsior Terra-Cotta Company.

CHICAGO. — The exhibition at the Art Institute, under the auspices of the Chicago Architectural Club, which closed April 11, eclipsed all former exhibits. Some eight hundred drawings filled the walls of four galleries. There were very few pen and ink renderings, most of the work being in water color, and many were exceedingly well done. There were no photographs, with perhaps one exception, and no regular working drawings which would show office methods. Very few products of the "allied arts" were admitted, one interesting instance being a bronze door for the new public library.

The Illinois chapter of the American Institute of Architects had offered as a prize to members of the Chicago Architectural Club, who had not been in independent practise more than two years, a gold medal for the best individual exhibit. Instead of the gold

LEHIGH BUILDING, PHILADELPHIA.
Addison Hutton, Architect.
Brown mottled terra-cotta bricks furnished by the Perth Amboy Terra-Cotta Company.

medal, however, three silver medals were awarded, to Messrs. H. M. G. Garden, H. T. Ross, and Victor Traxler.

The Art Institute has provided club rooms for the use of the Chicago Architectural Club in the Institute Building. This step is the first looking toward an affiliation of various kindred organizations at Chicago's art center. New York architects can appreciate the enthusiasm of the Chicago Club over the new departure by imagining the Metropolitan Museum located near their business center, and

BUSINESS BLOCK, MINNEAPOLIS, MINN.
H. W. Jones, Architect.

offering them not only the use of private club rooms, but access to all the gallery, lecture, and schoolroom privileges.

One more matter in connection with the Art Institute: it will soon have a new auditorium for its lecture courses.

Director French has a plan for distributing the work of the interior decoration which will greatly interest students and graduates. The work will be under one direction, to avoid as far as possible the criticism made even against the decoration of the new Congressional Library — a lack of unity. Mr. Chas. Coolidge is the architect.

The Institute of Architects is making some of their meetings interesting by devoting the greater part of a session to a very frank and free discussion and criticism of the buildings of a particular architect. Vivisection is good-naturedly indulged in to determine why a building is a failure or success.

The business depression and the large number of new office buildings in Chicago have combined to make offices a drug in the market. Good offices can be rented at a very low price.

As to prospective work, R. Bruce Watson has completed the drawings for two pumping stations for the city. The designs, which are very agreeable, are to be executed in brick.

Architect S. A. Treat has designed a new lecture hall.

N. S. Patton, architect to the Board of Education, has several new school buildings on hand.

S. S. Beman has made plans for the Studebaker Hotel at South Bend, Indiana, to cost $125,000.

The City Council has been juggling again with the limit of height of buildings. An ordinance was passed reducing it to 90 ft., but it has been raised again to 150 ft.

A matter exciting general interest on the streets, lately, has been the delivery and erection of the colonnade for the new Illinois Trust and Savings Bank. Each shaft is a monolith of Maine granite weighing some twelve or fourteen tons.

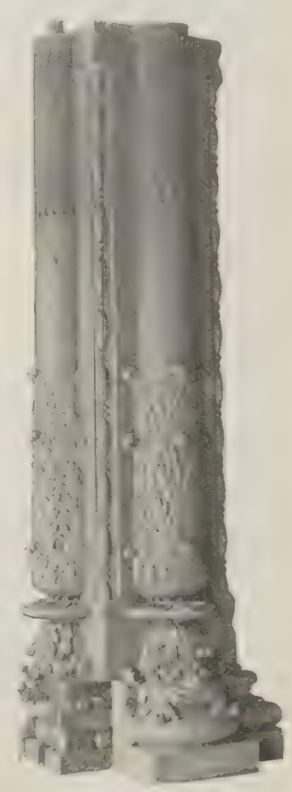
GROUP FOR THE BAPTIST PUBLICATION SOCIETY BUILDING, PHILADELPHIA, PA.
Frank Miles Day & Brother, Architects.
Executed in terra-cotta by the Conkling-Armstrong Terra-Cotta Company.

ST. LOUIS.— The unusual activity among builders in the suburbs is regarded as an encouraging sign. There are rumors of numerous large schemes in contemplation, but few are taking definite shape.

The Union Club, which was destroyed by the cyclone, has been rebuilt by architects Grable, Webber & Groves. It is an admirable piece of colonial work in rich red brick with white trimmings. A fine porch with large columns surmounted by a pediment marks the entrance. The building has also been enlarged and arranged for stores on the Jefferson Avenue side.

The original building, which was an interesting piece of Romanesque in white stone, was designed by architect T. C. Link, and had only been completed a year or so when it was destroyed.

The new St. Augustine Church on



TERRA-COTTA COLUMN, BUILDING FOR WM. WEIGHTMAN, CHESTNUT STREET, PHILA.
Willis G. Hale, Architect.
Made by Standard Terra-Cotta Company.

Herbert Street is a good example of Gothic architecture. It is built of pink brick with terra-cotta trimmings. The interior is to be finished with groined ceilings which extend to a height not usually seen at the present day. It will cost about $175,000.

The Lionberger Building, a noble example of Richardsonian work, which was destroyed in our million and a quarter dollar fire last month, is to be rebuilt by Shepley, Rutan & Coolidge. It is their intention to reproduce the original building as nearly as possible.

TERRA-COTTA CAPITAL, BUILDING FOR WM. WEIGHTMAN, CHESTNUT STREET, PHILADELPHIA.
Willis G. Hale, Architect.
Made by Standard Terra-Cotta Company.

PITTSBURG. — Business in the architectural and building lines is brightening, and a considerable amount of work is promised during the coming season.

Architect Wm. Kauffman is the successful competitor in the Greensburg Court House competition; the building is to cost about $400,000.

The Carnegie Steel Company, of this city, has been awarded the contract for the first steel fire-proof building to be erected in the Orient. It is an office and mercantile building to be erected at Tokio, Japan.

Several prominent business men here are interested in the erection of a new family hotel opposite Highland Park. Plans call for a fourteen-story, fire-proof structure, to cost $300,000.

The Exposition Society have planned to expend about $100,000 on improvements to their buildings this year.

The Third Ward Allegheny School Board are contemplating the erection of a brick school building to cost $150,000. It will contain a manual training school and all departments for the education of children in various industrial lines.

Architect Wm. Ross Proctor has completed plans for a new hospital which he will submit to the board of managers of the West Penn Institution. The complete plans call for fourteen buildings.

Architect S. F. Heckert is receiving bids for the erection of the convent building at Millvale, which is to cost $250,000.

The same architect is also preparing plans for a five-story brick Casino for the St. Michael's Roman Catholic congregation on the South Side.

Architect J. L. Beatty was the successful competitor for the Woman's U. P. Hospital, which will be erected on Sandusky Street, Allegheny, at a cost of $40,000.

FRIEZE IN MAIN CORNICE, PHILADELPHIA DENTAL COLLEGE, 18TH AND BUTTONWOOD STREETS.
Wilson Brothers & Company, Architects.
Executed in terra-cotta by the Excelsior Terra-Cotta Company.

Architect Edward Stotz will prepare plans for the new South Side High School.

Prof. H. L. Braun will build a four-story brick and stone business block, auditorium, and apartment house on S. Highland Avenue, to cost $50,000.

Architect F. C. Sauer has been commissioned to prepare plans for a large brick and stone church and monastery for the Capuchin Fathers, to be erected at Canal Dover, Ohio.

MINNEAPOLIS.— An inquiry among the architects of the Northwest, conducted by the "Improvement Bulletin" of Minneapolis, brings out the fact that few, if any, architects are anticipating any very large undertakings this season.

The architects of Wisconsin have secured the passage of a bill requiring all persons desiring to practise architecture to pay annual fee and be subject to an examination. Illinois architects are also agitating a similar bill. We sincerely hope this will spread until it is requisite in every State.

Our Governor covered himself with glory recently by vetoing a bill framed and engineered through the legislature, changing the site of proposed new hospital for the insane, from Aroka to Hastings. Inasmuch as the State had purchased a site at the former place in good faith, the citizens making a liberal donation to same, the matter was considered by him as closed, and any further agitation as unworthy the dignity and honor of the State. He was upheld by a large majority of the legislature.

Among the larger improvements under way at present may be mentioned: brick residence for Geo. H. Partridge, by Long & Kees, architects, to cost $20,000. Public Library at Rochester, Minn., by C. S. Sedgwick, architect, to cost $18,000, won in competition. School building at Kaukauna, Wis., by Orff & Joralemon, architects, to cost $21,500; and another at Jordan, Minn., same architects, to cost $15,000.

There will evidently be large improvements in the smaller towns, but the cities will do no very great building.

TRADE LITERATURE.

THE recently published catalogue of the Fawcett Ventilated Fire-proof Building Company is before us. The particular system of fire-proof construction which is manufactured and put on the market by this company is in several respects quite different from the ordinary arch block construction. It assumes that fire will readily heat through thin terra-cotta, just as water can be made to boil in an earthen pot, and that if the flange of a beam be once heated sufficiently the beam will expand, deflect, and come down with the floor, causing damage to the building, as well as to the floor itself; and therefore, in order to afford insulation of the lower flange, the Fawcett blocks are so devised as to interpose between the metal and the terra-cotta, a space through which air, when heated, may freely circulate. This is the principle of the Fawcett floor, and it is claimed that though a fire may heat through a plaster ceiling, or may heat the terra-cotta to even a white heat, before it can reach the one vulnerable point, the I beam itself, it must heat through a layer of air which is not confined, and the more intense the heat the more rapid the circulation of the air.

Another claim of the Fawcett construction is that the fire-proofing blocks or sections can be laid without any centering whatever, and will form a ground for a perfectly level and even ceiling. The sections are made in the form of a horseshoe cylinder. These are cut with a bevel at each end of a length so as to just fit between the flanges of two beams, the ends being further rebated so that the lower portion of the terra-cotta section dips below the flange of the beam. As soon as these sections are in place the spaces above are filled in with concrete to receive the finished floor. This construction is doubtless familiar to all our readers, for the Fawcett construction is long past the experimental state, and has been used and

recognized by many leading architects in this country and abroad. It can be adapted to any building or any circumstance, and can be built to carry a superimposed load of anywhere from 50 to 1,500 lbs. per square foot. The catalogue gives a list of the buildings in which this construction has been used, which includes many prominent buildings in our large cities.

NEWS OF THE MONTH.

THE contract for front and inside brick for the Dover Street Bath House has been given to Waldo Brothers.

WALDO BROTHERS have secured the order for front bricks for Paul Revere Schoolhouse, Boston.

THE WHITE BRICK AND TERRA-COTTA COMPANY have removed their New York office from 92 Liberty Street to the Presbyterian Building, 156 Fifth Avenue.

THE FAWCETT VENTILATED FIRE-PROOF CONSTRUCTION COMPANY have contracted for the structural steel work and fire-proofing for the new Probate Court Building, East Cambridge, Mass.

POWHATAN face bricks will be used on alteration of building on Beach Street, Mr. Hennessey, the owner, having placed the order with Waldo Brothers.

THE RALSTON BRICK COMPANY has secured the contract for supplying the brick that will be used in the buildings of the University of the State of New York.

WALDO BROTHERS have sold Alsen Portland and Hoffman Rosendale cements to Richardson & Young for use on section 9, Boston Subway.

HAVING completed the improvement in their plant, which consisted of putting in new machinery, the Ralston Brick Company is running to the limit of their capacity on orders that had accumulated.

C. EVERETT CLARKE & Co., builders of the new building on Congress Street, near Atlantic Avenue, have contracted with Waldo Brothers for Brooks, Shoobridge & Co. Portland and Hoffman Rosendale cements.

THE PITTSBURG TERRA-COTTA LUMBER COMPANY has closed contract for the fire-proofing of the new Baltimore Court House, John Gill & Sons and D. W. Thomas, general contractors. This contract amounted to about $65,000.

THE NELSONVILLE SEWER PIPE COMPANY, of Nelsonville, have purchased an Eagle Re-press from the American Clay-Working Machinery Company. The Nelsonville people report the outlook for business much improved.

WALDO BROTHERS have closed a contract with the city of Newton for the supply of Portland cement for the season of 1897. The city decided to use Brooks, Shoobridge & Co. Anchor brand, although other brands were offered at lower figures.

THE UNION AKRON CEMENT COMPANY, Buffalo, is furnishing their Akron Star Brand Cement on the following work: new building for the Buffalo Street Railway Company; No. 1 School House; also for the fire-proofing in the Lenox Flats, the Otto Building, and the Evans' Building.

CONTRACTS have been recently closed for placing the Bolles Sliding and Revolving Sash in the following buildings: United States Government Hospital, Brooklyn, N. Y.; warehouse, Geo. Blome & Son, Baltimore; Fourth Regiment Armory, Baltimore; large apartment house, Washington, D. C.

THE DES MOINES BRICK MANUFACTURING COMPANY, of Des Moines, Iowa, one of the most progressive firms in the West, are making some extensive improvements and will put in the Eagle Re-presses, and an automatic table of the American Clay-Working Machinery Company's make.

THE STANDARD TERRA-COTTA COMPANY have secured through their New England agents, O. W. Peterson & Co., the contract for the terra-cotta on the Registry of Deeds and Probate Court Buildings, East Cambridge, Mass., O. W. Cutter, architect, Thomas H. Connell, builder.

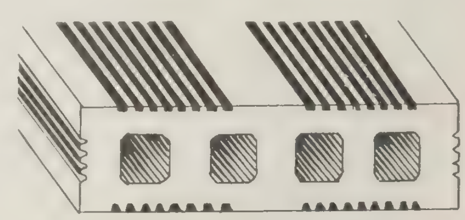
THE new brick plant of W. S. Ravenscroft & Co., at Daguscahonda, Penn., has begun operations, and has already enough orders in hand for gray and buff brick to keep them going on full time for several months. The plant is equipped with Simpson Brick Machines.

THE AMERICAN CLAY-WORKING MACHINERY COMPANY, of Bucyrus, has found it necessary to further increase its force both in the mechanical and clerical departments.

The shops are working full time in every department, some branches putting in extra time in their effort to keep abreast of the orders. More traveling men have been put on the road. There is a general air of old-time business rush with this establishment.

THE PHILADELPHIA AND BOSTON FACE BRICK COMPANY have closed the following contracts: 250,000 plain buff brick, all the molded buff brick, for new passenger station, Boston & Maine Railroad, Manchester, N. H. Red face and molded brick for new high school at Great Barrington, Mass., Henry Vaughan, architect. Molded brick for Norwood Press Company Building, at Norwood, Mass. Molded brick for Phillips Building, at Washington, D. C. Molded brick for Pope Manufacturing Company Building, Washington, D. C. Molded brick for Schiller Turn Verein Building, at Pittsburg, Penn.

THE NEW YORK AND NEW JERSEY FIRE-PROOFING COMPANY has just placed on the market a new style hollow bonding brick, an illustration of which we show herewith. These bricks differ from the regular make of hollow brick in that the holes run crosswise instead of longitudinally. Their size is 8 by 2⅜ by 3½. The idea was suggested by Mr. Snyder, architect of public schools, New York, and they are now specified in the new school buildings.



CHAMBERS BROTHERS COMPANY are about making shipment of some $15,000 worth of brick-making machinery to Nashville, Tenn., to be exhibited at the Tennessee Centennial during the coming summer. They have erected a building especially for their own use, and will have a very interesting exhibit of machinery in practical operation. It is the largest exhibit of the kind that they have ever made, and will embody both end-cut and side-cut auger machines, steam power re-press, disintegrators, dry pans, clay elevators, and dryer equipment, etc.

THE AMERICAN MASON SAFETY TREAD COMPANY, which has nearly completed its work on the Boston Subway, has closed several important contracts lately. It is remodeling the great stairway of Jordan, Marsh & Co., Boston, the iron edge left for the purpose of retaining rubber mats having proved a source of danger. Safety treads are to be placed upon the steps of the Administration Building of the Metropolitan Park Commission, at Revere Beach, Mass., Stickney & Austin, architects; the new Tufts Building, Boston, Rand & Taylor, Kendall & Stevens, architects.

The granite steps of the Lowell Post-office are to be made safe with this material. The company is now putting out a non-slipping, unwearable sidewalk light, to be known as "The Mason Light."

The Excelsior Terra-Cotta Company will supply the architectural terra-cotta for the new building for the Catlin estate, Asylum and Main Streets, Hartford, Conn., W. C. Brocklesby, architect; office building for Mr. John Dobson, 9th and Market Streets, Philadelphia, Charles McCaul, architect; the Inter-Ocean Building, Washington, D. C., T. F. Schneider, architect; office building, corner Broadway and Spring Street, Brunner & Tryon, architects; and office building, 598 Broadway, R. Maynicke, architect. All of the above are to be executed in gray terra-cotta.

Answering our request that a list of new contracts made for supplying brick be furnished us for publication, the Columbus Brick and Terra-Cotta Company, Columbus, O., send enough such to fill a column. The following list will indicate the very large field that this company is capable of covering: Dormitory No. 3, Holyoke College, Massachusetts, G. Powell Karr, architect; flats, 134th Street and Seventh Avenue, New York, Geo. F. Pelham, architect; residence, 96th Street, near Central Park, New York, G. A. Shellinger, architect; five flats, 104th Street, New York, G. F. Pelham, architect; five flats, 115th Street, New York, Neville & Bagge, architects; residence, Milwaukee, Wis.; Casper Building, Milwaukee, Wis.; residence, Charleston, W. Va.; Fair Building, Chicago; Townsend Hall, Ohio State University, Columbus, O., Peters, Burns & Pretzinger, architects; Administration Cottage, Boys' Industrial School, Lancaster, O., Yost & Packard, architects.

I. W. Pinkham Company, Boston, announce their removal from 188 Devonshire Street to more spacious quarters at 206 Devonshire Street, corner of Franklin Street. Although it is but little over a year since the firm moved from their Milk Street office to larger quarters at 188 Devonshire Street, yet the growth of their business has made it necessary to change again to a location that would give them still more room. In their new quarters they have splendid facilities for the display of their samples of fancy front brick and terra-cotta, the arrangement being such that the exhibit has the full benefit of facing the unobstructed light of a south exposure. It is the design of the company to make a large and very complete display of building materials, so that parties seeking information on lines of this nature will be enabled to obtain an accurate idea of their effect when "laid up" in sections.

The firm would be glad to correspond with any clay manufacturers who are not represented in New England, with a view to handling their accounts.

Elk County, Pennsylvania, has in recent years developed great resources in clay, and it may be of interest to state that every one of the carboniferous clays of the lower cola measures are found at some point in the county. At no point, however, is there such a display of the entire group as is found upon the territory known as the "Ellis lands," lying in the most southern part of the county upon the Pennsylvania & Buffalo, Rochester & Pittsburg, and Erie Railroads.

This tract comprises over 6,000 acres of land, and is of easy access, having also a large area of coal. Natural gas has also been found upon the property.

The clays have been tested by local experts who pronounce it a superior deposit, some seven or eight distinct shades of buff clay being found with colors ranging from cream buff to chocolate.

A vein of the celebrated flint clay has been opened and the highest grade of refractory brick made therefrom.

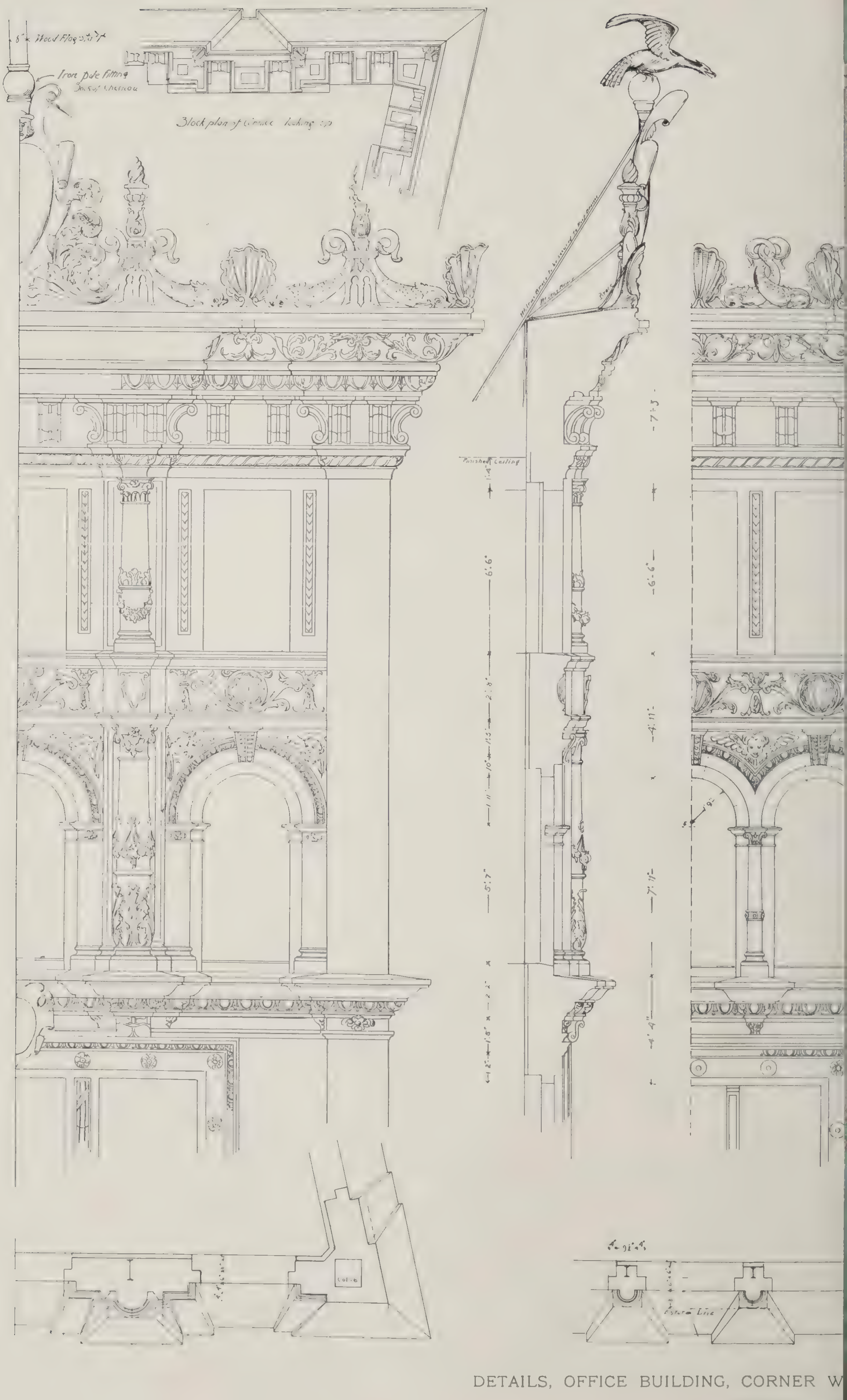
An advertisement in another column offers this very desirable property for sale.

FOR SALE.

TWO COMPLETE OVER-GEARED 8 FT. DRY PANS, WITH 48-IN. PULLEYS, ENTIRELY NEW.

FOR PARTICULARS INQUIRE OF SMITH & CAFFREY, SYRACUSE, N. Y.

INDEX TO ADVERTISEMENTS.



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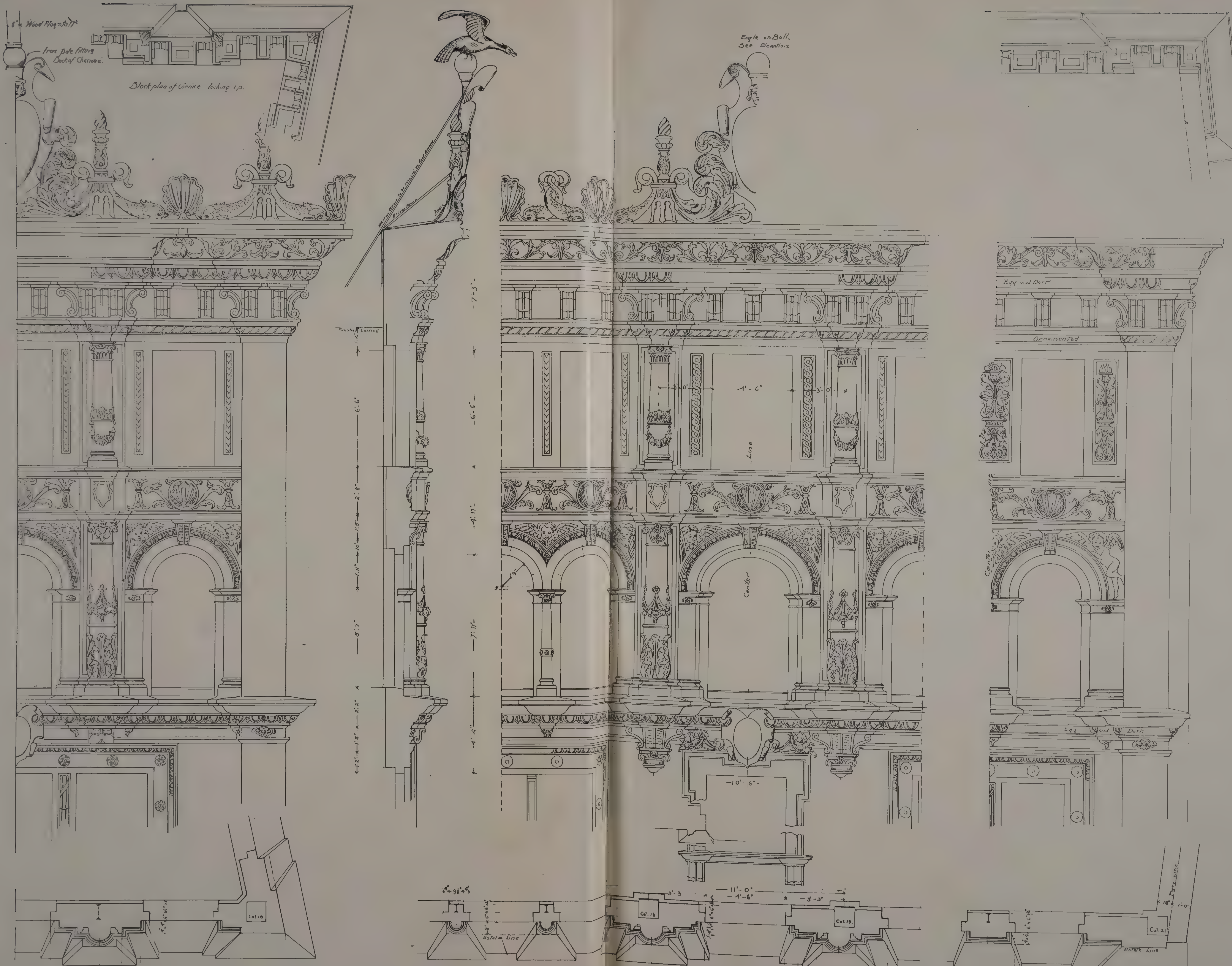
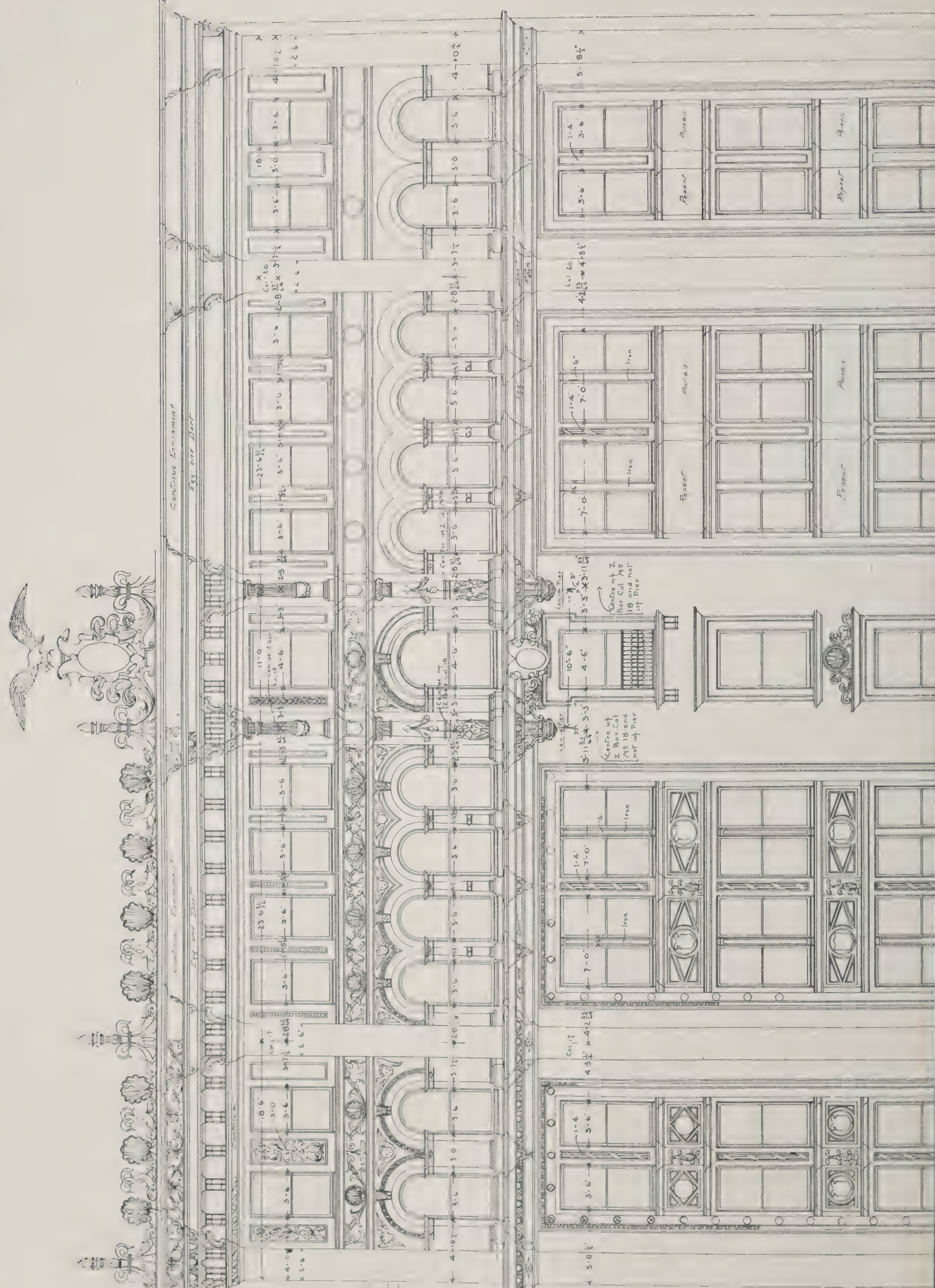
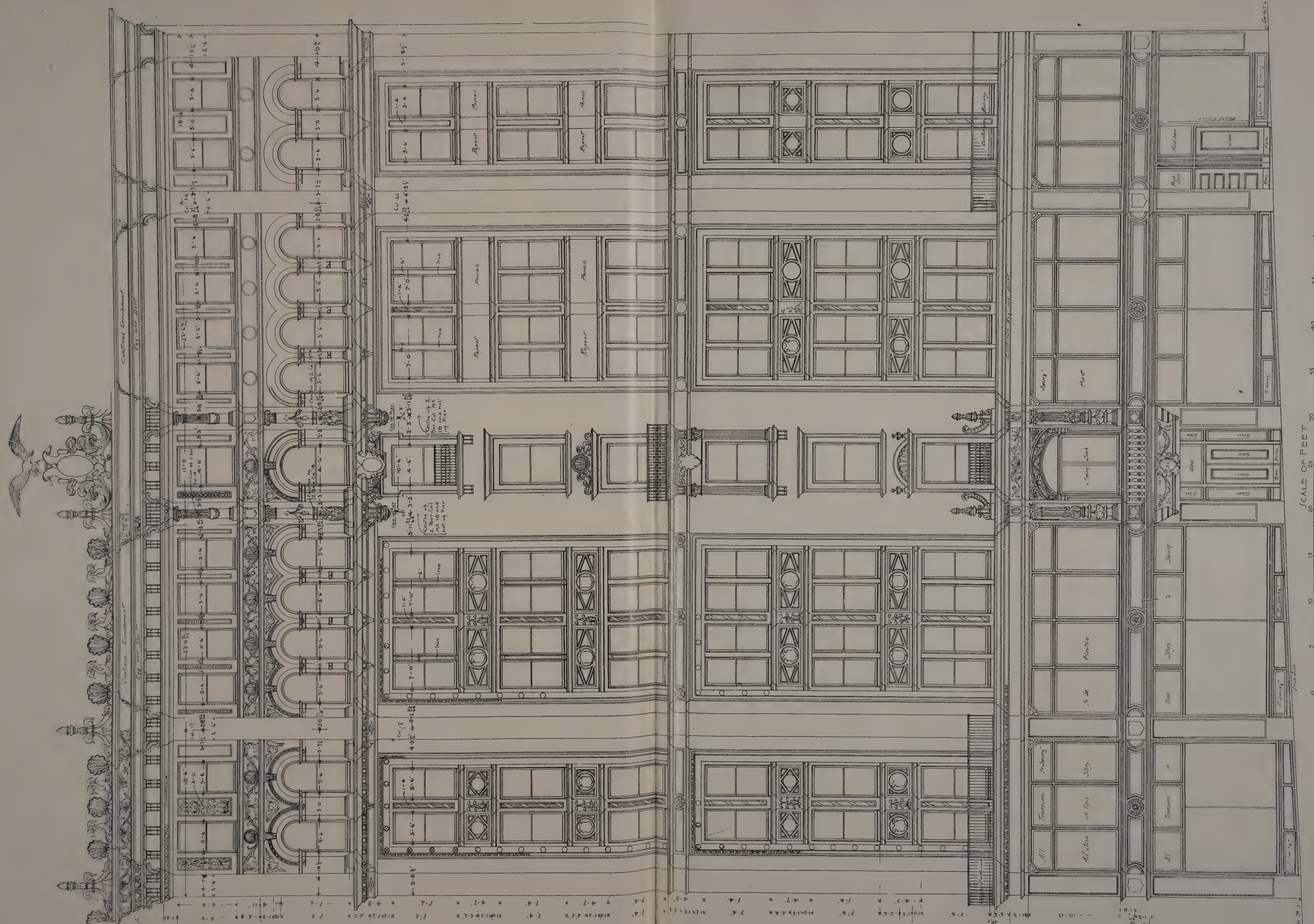
WINSLOW & W



DETAILS, OFFICE BUILDING, CORNER WASHINGTON AND BROMFIELD STS., BOSTON.

WINSLOW & WETHERELL, ARCHITECTS.





OFFICE BUILDING, CORNER WASHINGTON AND BROMFIELD STS., BOSTON.

WINSLOW & WETHERELL, ARCHITECTS.

NORTH ELEVATION.

RECITATION HALL, WOMEN'S COLLEGE
STONE, CARPENTER

North Elevation.

Front Elevation.

RECITATION HALL, WOMEN'S COLLEGE, BROWN UNIVERSITY, PROVIDENCE, R. I.

STONE, CARPENTER & WILLSON, Architects.

East Elevation.

RECITATION HALL, WOMEN'S COLLEGE, BROWN UNIVERSITY, PROVIDENCE, R. I.

STONE, CARPENTER & WILLSON, Architects.

SCALE

RESIDENCE FOR P. A. O'NEIL Esq.
EAMES & YOUNG Architects. ST. LOUIS MO.

MATERIALS –
BASE —— WHITE LIMESTONE
TRIMMINGS – WHITE TERRA COTTA
WALLS —— LIGHT GRAY BRICK.
DORMERS – COPPER

VOLVME VI MAY 1897 No. 5

THE BRICKBVILDER

OFFICE 85 WATER STREET BOSTON

THE BRICKBUILDER.

AN ILLUSTRATED MONTHLY DEVOTED TO THE ADVANCEMENT OF ARCHITECTURE IN MATERIALS OF CLAY.

PUBLISHED BY

ROGERS & MANSON,

CUSHING BUILDING, 85 WATER STREET, BOSTON.

P. O. BOX 3282.

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CARE OF MASONRY.

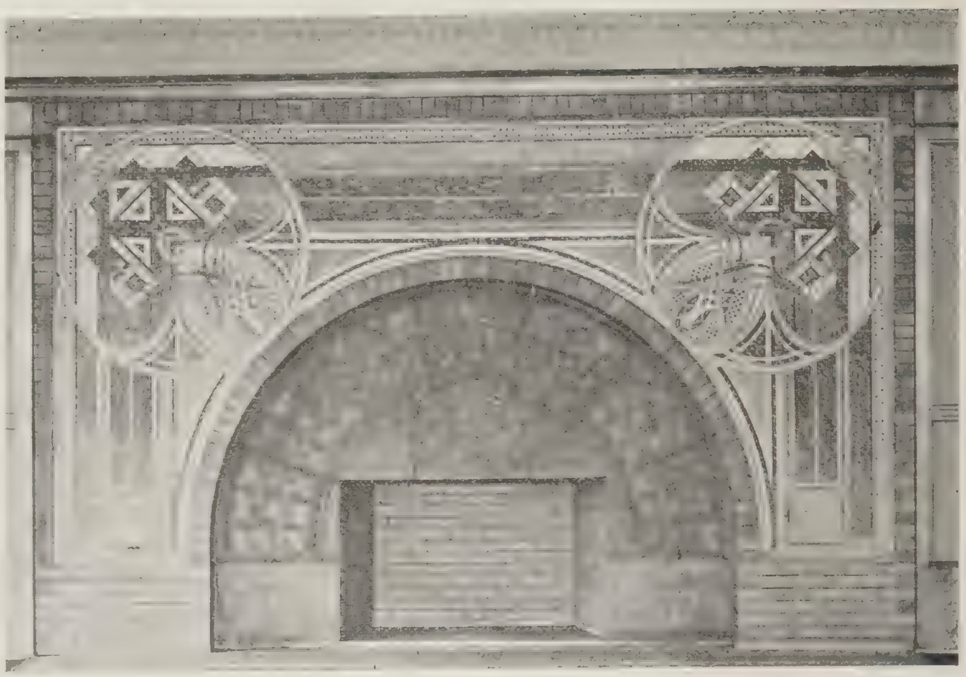
WE understand that Mr. Barnard R. Green, who has been in charge of the work of the Congressional Library in Washington for a number of years, if not from its start, has been appointed by Congress permanent superintendent and custodian of the building. This appointment points a moral which is deserving of more frequent application than is unhappily the case in American cities. Our architects and builders may put up a building never so fine, may use the best of material and the utmost care in application, but unless the structure receives intelligent care after it is occupied, and the repairs, which, from time to time, are necessitated in even the best of structures are made judiciously and with consideration for the character of the construction, the building is bound to deteriorate quite rapidly. And the fact that Congress has seen fit to recognize this condition and has placed the magnificent building permanently under the care of a person who is thoroughly familiar with it, and is competent to keep it in its pristine excellence, is, we hope, at least the beginning of a new order in regard to our public buildings.

The excellence, suitability, and permanent qualities of burnt clay as a building material, preeminently fitted for use in connection with modern structures, can hardly be questioned in view of the greatly increasing application of this material in our large cities. If properly taken care of, there is no reason why a brick and terra-cotta building should not last for centuries in perfectly good condition. On the other hand, any material is bound to suffer from neglect. It is not enough to build a brick wall and expect it to stand forever without any care, nor will the utmost skill in the use of concealed iron supports for terra-cotta avail to keep it in thoroughly good order indefinitely. It must be watched, and especially in our climate it must be repointed whenever the mortar shows signs of decay, and must be cleaned at sufficient intervals to prevent the formation of any of the fungous growths which attach themselves quite readily to building materials and speedily cause disintegration. For these reasons a custom ought to be adopted here, which has been for many years prevalent abroad, of assuming that the architect who builds a building is naturally the one in whose care as a structure it shall remain indefinitely, and that it is as much his function to guard his creation after it is turned over to the owners as it is to see that proper materials are used in the first place and laid up in the best manner. We believe that a great deal of the objection which has at times been urged against brick or terra-cotta has been suggested by observation of structures imperfectly cared for, which, with perhaps not the best of materials to start with, afford a too easy prey for the elements; and the fact that there are so many buildings of brick which have endured in this immediate vicinity for over one hundred years, and are still in a perfectly good condition, shows that with even ordinary good care brick or terra-cotta are practicably indestructible. Any one has but to examine the Harvard and Massachusetts Halls at Cambridge, which were built in the last century, to see how well brick will endure under proper conditions. On the other hand, we have seen buildings in which was used thoroughly first-class brick laid in the best of cement, which had been allowed to go to pieces, the frost had worked into the joints, and ten years after the structure was handed over to the owners it looked older and of apparently poorer materials than the Cambridge examples just noted. The practise now seems to be for the architect to build his building, and as soon as the contract is completed, roll up his drawings, pack them away, and speedily forget the structure, to concentrate his energies on the next job he is hunting for. Even if he remonstrates with his former client against neglect of his building his warnings are seldom heeded, for few property owners appreciate that a building must be not only well constructed but well groomed.

The points at which a building will suffer most are in the weatherings, where vertical joints are exposed on top of a horizontal course, such as top members of cornices, sills, copings, etc. Some constructors are unwilling to use terra-cotta for any of these purposes, knowing how seldom an owner will intelligently appreciate the necessity for attention to such features, though so much better effect can often be secured that it is well worth the price of a careful inspection each spring by a competent mechanic, and a few dollars expended in some good old-fashioned pointing with a mortar of lime and sugar, or of one of the cements which will not stain the terra-cotta. We recall at this moment a prominent commercial building all of the details of which are of terra-cotta, including a heavy, foliated band at line of upper floor which serves at intervals as a sill for the windows, and of necessity presents many vertical joints, protected only at top by the pointing. The annual bill for repointing, during the last five years, has not averaged twenty-five dollars. In September and in March it is gone over under the architect's direction, and possible repointing anticipated. If this supervision is continued, the terra-cotta ought to last for centuries.

But pointing is not all. Conversing with a builder from a city where soft coal soot is painfully in evidence, we found he was not in favor of using enameled terra-cottas or brick for external treatment

of city fronts, for the reason that even the best enameled surface will catch the dust and soot and in a short time will look like ordinary brick or terra-cotta. He seemed to think a suggestion of applied soap and water was impracticable. That is like saying, if one's hands are dirty, there is no use washing them, for they will soon become dirty again. We, in Boston, are fortunately spared the sooty atmospheric conditions which afflict our Western cities, but there is plenty of dirt here, nevertheless, and if a building is to be the joy forever which its possibilities will permit, its toilet must be regularly attended to. A terra-cotta front of 90 ft. by 125 ft. high can be thoroughly cleaned and repointed for less than $250, and this ought to be done at least once in three years, and in some localities once a year. And in the long run, it is believed that property owners would find such care bestowed upon a building would be well worth all it would cost in money, while the esthetic gain to the community would be no less real, if less easy to reckon in dollars.



BRICK, TERRA-COTTA, AND MOSAIC MANTEL, BANQUET ROOM, ST. NICHOLAS HOTEL, ST. LOUIS, MO.
Louis H. Sullivan, Architect.

THE PALAZZO POLLINI SIENNA.

THE Palazzo Pollini is one of the smaller brick palaces of Sienna, but it at once attracts attention by the beauty and correctness of its proportions. The façade is divided

into three stories, of which the first has a very decided batter. There is no ornament of any kind about this story. The principal story has marble architraves, and caps to the windows, and the third story has also marble architraves.

Some of the belts are of marble, and some of molded brick. The wall is capped with a very rich terra-cotta cornice, and wide projecting eaves. The interior presents nothing of interest; the design is attributed to Baldassan Peruzzi. A measured detail of the building is shown on plate 48.

OBITUARY.

MR. W. S. FRASER, architect, of Pittsburg, Pa., after an illness of nine months, died at his home, April 27, at the age of forty-five years.

Mr. Fraser studied architecture at the Royal Academy, London, and with William Burgess, one of the best known of English architects. In 1879, he opened an office at Pittsburg for the practise of architecture. Among the buildings designed by him are the Bank of Commerce Building, Arbuckle Building, Joseph Horne Building, and the Sixth U. P. Church, all of Pittsburg.

ILLUSTRATED ADVERTISEMENTS.

IN the advertisement of the Excelsior Terra-Cotta Company, page iv, is shown an interesting series of terra-cotta details of the Romanesque style, employed by Architect George L. Morse in the new store building for Abraham & Straus, Brooklyn.

BOHEMIAN NATIONAL HALL, New York City, the architectural terra-cotta for which was made by the New Jersey Terra-Cotta Company, is illustrated in the advertisement of that company on page ix.

A VERY interesting illustration of fire-proof floors is shown in the advertisement of R. Guastavino Company, page xiv. It shows to good advantage their system of fire-proof construction, the first floor being of the dome type carried on tile ribs with tension angle

WINDOW PEDIMENT.
Executed in terra-cotta by the New York Architectural Terra-Cotta Company.

irons built inside of same, and the upper floors of barrel arches with tile bracing ribs. The same dome floor construction is to be used for the first floor of the adjoining building and its duct system for hot air. This system of floor construction was selected because of the very heavy loads required. Rand & Taylor and Kendall & Stevens, architects.

Architectural Terra-Cotta.

BY THOMAS CUSACK.

(*Continued.*)

IN responding to numerous requests for reliable data on cornice construction, it may be advisable to start with one of rather commonplace character. Where the projection of a modillion cornice does not exceed 2 ft. 6 ins., it may be supported in the simple and inexpensive, but very effectual, manner shown at Fig. 22. Provision is made for a piece of 1 in. galvanized iron pipe, which is passed through the partitions of every modillion, the chambers of which are then filled from the top bed before setting. The wall would not be less than 12 ins., or more than 1 ft. 4 ins., and in either case the bond could be made the full thickness. If not, the end of the pipe would be allowed to extend to the inside face of wall. The introduction of the pipe serves a twofold purpose. It increases the strength of the bracket *per se*, and it affords a ready means of anchoring it down. Placing the anchor bolts on inside face of wall, instead of building them into the wall, has likewise some important advantages. It gives additional leverage, saves the trouble of exact spacing, and the rods do not stand up in the way of the masons while the wall is being built. The anchor plates are built in joint of brick piers, say, 4 ft. below cornice, and when over the window openings, as near the lintel as possible, in which case shorter bolts would be used. One end of the bolt being forged so as to fit tightly into end of pipe, the other end, passing through the hole in anchor plate, is screwed down to required tension by nut on the under side. The spaces between brackets being then built up level, the top member of cornice is set to line, and in most cases it may be anchored back to roof beams, after the manner indicated in section (Fig. 22).

Where a parapet wall is intended, its weight when built would help to counterbalance the projection of cornice. That is a factor worth taking into account in fixing the length and size of the anchors, but must not be used as an excuse for abandoning them. There have, however, been instances known to the writer where they were omitted by the contractor, although provided for in making the terra-cotta, and specifically called for on the setting drawings that accompanied it to the building. This kind of "economy" is usually shortsighted, and in one or two cases it has proved criminal.

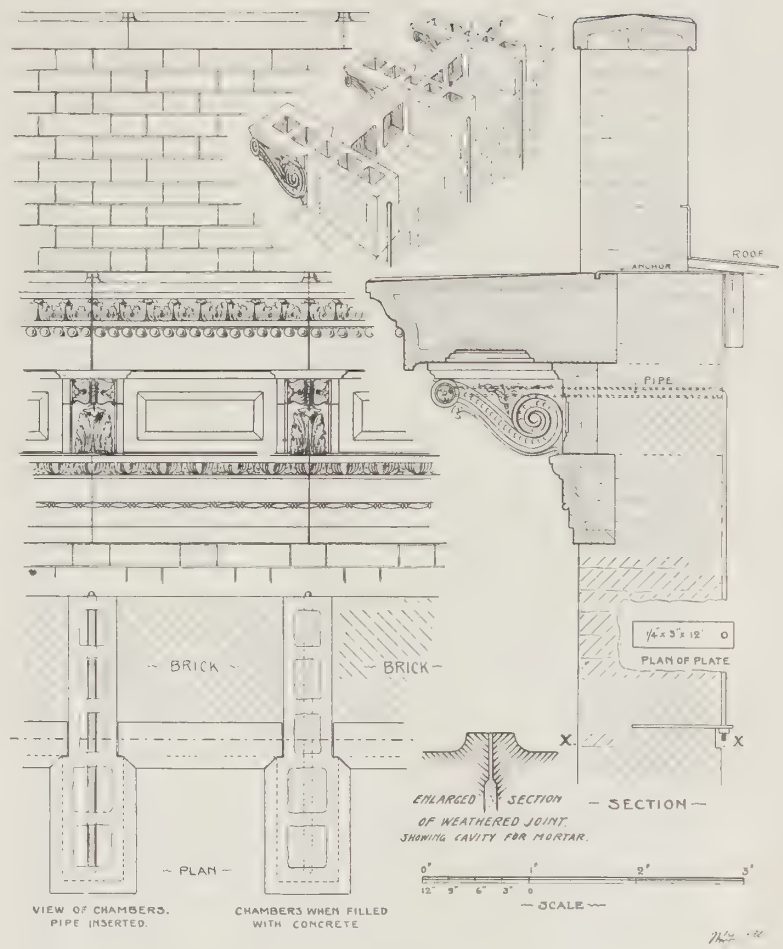


FIG. 22.

A portion of the cornice toppled over onto the scaffold, which also gave way, and in each case with disastrous consequences, resulting in a loss of life, which was directly due to the omission of a few inexpensive and easily applied anchors. In all work of this kind it is certainly "better to be sure than sorry."

Within the limits stated, viz., 2 ft. 6 ins. projection, this arrangement possesses a wide margin of safety. A glance at the diagram will show that if this cornice, when set, be tested by loading it beyond the verge of stability, it would not be the modillions, nor yet the anchors that must fail, but the wall itself, which would break at x x,—obviously its weakest part. To do this, however, would require a much greater weight than is at any time likely to be placed upon a cornice, and the tendency in that direction is fully counteracted by the anchors attaching it to the roof timbers. A scheme substantially the same as this was submitted some years ago, by the writer, to a leading firm of architects, and having received their approval, was carried out. It has again been adopted by them, and

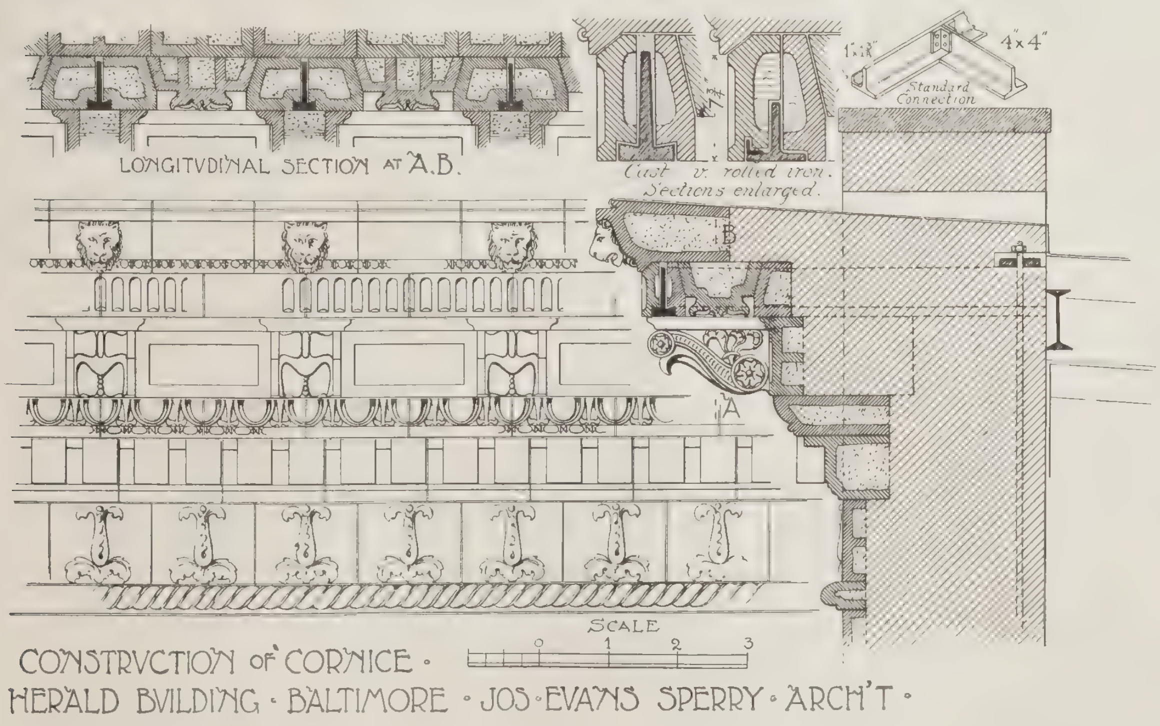


FIG. 23.

by other architects on several occasions, from which circumstance its efficiency may reasonably be inferred.

In cornices of greater projection, other schemes of iron support become necessary. One of these — and an excellent one it is — we

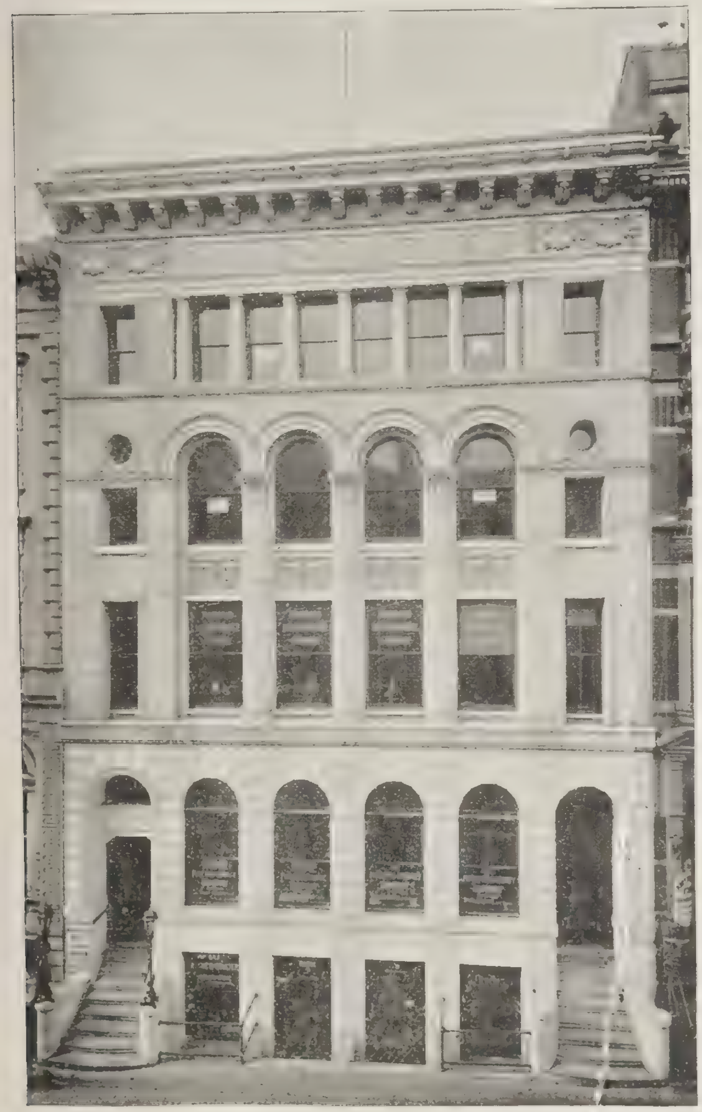


FIG. 24.

give at Fig. 23. For this device we are indebted to Mr. J. E. Sperry, Baltimore; and considering the number of times he has used it on important buildings without much modification, there can be no doubt as to its practicability. The first special feature to be noticed is that the cantilevers, as well as the inverted tee running parallel with the building, are *cast* iron. In this he claims two advantages: one being that they are less liable to rust; the other, that a flange such as shown in drawing cannot be obtained in rolled sections. In so far as the cantilevers are concerned, the value of this particular section is not apparent. but in the longitudinal tee its advantage is very decided. The pieces of terra-cotta forming fascia fit into the dovetail angle in such way that when the crown molding has been set they are securely locked, and do not require any additional anchors.

We think, however, that the same thing could be accomplished by using an ordinary rolled section, on one flange of which a small angle of, say, 1 by 1½ ins. may be riveted, as shown in the enlarged section. Or, a special tee, known as No. 156, may be obtained from the Carnegie works which approximates sufficiently close to the casting to change places with it. This would not be required in the soffit blocks, where eight pieces are fitted into each compartment, with an iron frame on three sides, and a brick backing on the fourth. Seven of these pieces being set in place separately, it but remains to drop in the center panel as a key, and the whole thing is then rendered immovable. There can be no doubt as to the stability of a cornice made and erected in this manner. The only serious objection to any part of it is the exposure of the longitudinal tee, in soffit between the modillions, which would have to be painted to match the terra-cotta. How that may be avoided will be shown in subsequent illustrations, where cornices of much greater projection are carried without exposing any of the iron construction. In view of what has just been said in connection with this one, however, we have taken the liberty of reproducing another of Mr. Sperry's cornice designs, applying to it a style of construction and support which would be less expensive, and, we think, preferable in other respects.

The Maryland Life Building, Baltimore (Fig. 24) has a cornice, the construction of which is substantially the same as that discussed in the two preceding paragraphs, and shown in detail at Fig. 23. In the revised method now proposed (Fig. 25) two radical changes are introduced, which, being made, would involve a third. Instead of the cast-iron cantilevers, which have been shown to possess no special merit, we would use a 4 by 4 inverted tee of rolled iron, tailed down by similar anchor bolts; and as these pass through a continuous channel, they need not be less than, say, 5 ft. apart. The longitudinal tee bolted to the cantilevers is omitted altogether, it, as we shall see, being rendered quite unnecessary. These two changes compel, or rather permit us to make each piece of cornice in one piece from center to center of modillions, with coffer panel and rosette in soffit solid and complete. The blocks so made rest directly on the flanges of the cantilevers, the web in each case being provided for by a slight rebate in the joint. The modillions have little more than their own weight to carry, and being deep in proportion to their projection, might well be considered self-supporting. Yet, in view of possible fracture in transit, or of chance knocks during setting, we would insert a pipe in each of them, filling the chambers with concrete, as in Fig. 22. The terra-cotta maker would not charge any-

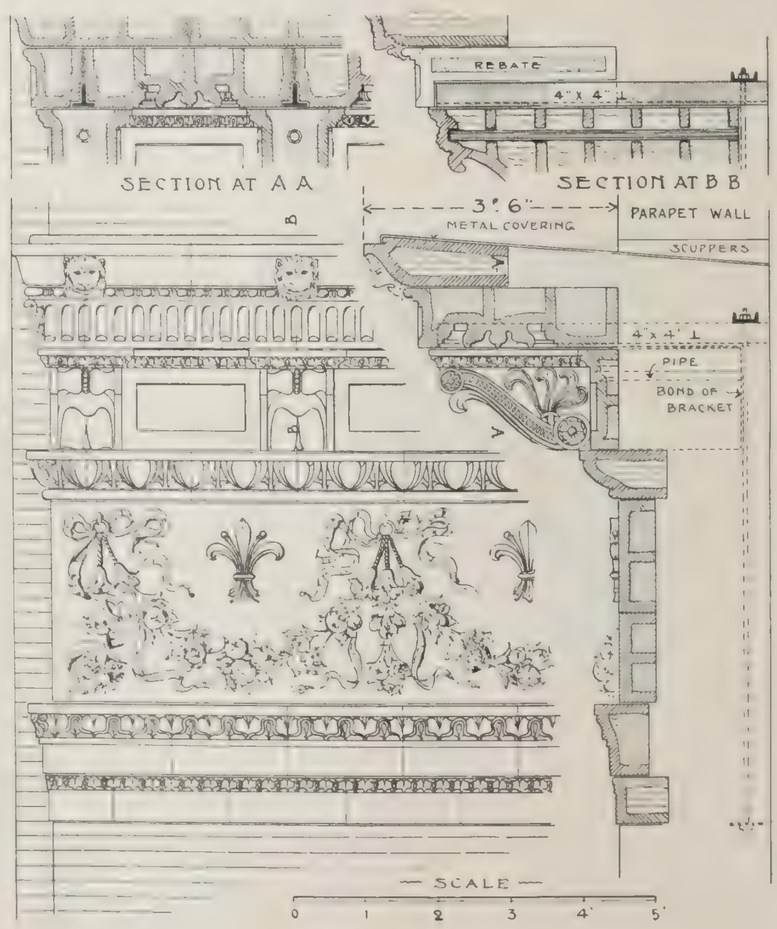


FIG. 25.

thing for the hole; and the use of a few feet of pipe and a little cement, while enabling the contractor to sleep soundly in his bed, would never drive him into bankruptcy.

In saying that this arrangement would *permit* these blocks to be made in one piece, instead of in ten pieces, we use the word advisedly, for in that there are certain advantages that do not appear on the surface. To joint work into pieces unnecessarily small is hardly less objectionable than to insist upon having them made too large. Excessively small blocks were often resorted to in past years by men who had not learned how to make large ones. The alleged intractability of the clay was often enough made a convenient scapegoat for their own shortcomings in the use of it. While it is gratifying to know that some of these men are gravitating towards the rear of the procession, there is reason to fear that the class still survives. A few instances of recently executed work show but too plainly that it is not yet wholly extinct. Architects have at times been talked into acquiescence. accepting in half a dozen small pieces a single member that any really competent clay-worker would have elected to make in one, and that, too, without doubt or misadventure. We see in Mr. Sperry's scheme a well-considered and altogether praiseworthy effort to overcome a supposed deficiency in the material, but one which, we are glad to assure him, can be overcome to a much greater extent than he has been led to suppose.

The particular block which we propose to make in the present instance is 3–0 x 2–9 x 10 and would weigh, when burned, about 500 lbs., or less than one third the weight of blocks which have been made with unqualified success. This, indeed, would be considered an almost ideal block in point of shape, as well as in that of size, and, what is of equal importance, its situation is such that true alignment is imperative only on face and soffit. It, as the drawing shows, may be pressed open on the top bed, which would compel the mason to fill the chambers, in itself a thing to be commended. In this and in many other respects, not only would it be *better* in one piece than if made in ten pieces, but it would likewise be produced at considerably less cost.

One mold of medium size would certainly cost less to make than eight separate molds, required under the previous system of jointing. In like manner, we have but one block to press against the ten distinct pieces otherwise necessary to make up its equivalent in cubic inches of work. The comparison begins, but it does not end here. Instead of one piece, we have ten pieces to handle in all subsequent stages. Even when burned, we have them to assemble, to fit, mark, ship, and finally to set when they reach the building. Whether viewed as a question of good construction, or as one of profit and loss, the balance is decidedly in favor of the solid block, as against the ten pieces. It will therefore be seen that even in terra-cotta making "the first false step" is fraught with and followed by a train of evil consequences — a sufficient reason why it should be eschewed at the outset.

(*To be continued.*)

WE haven't been very busy in the office lately. In fact the hard times have left us almost stranded, a condition which we feel we share with a great many others. It has some compensations, however. I have been amusing myself lately with a design for an office building, and as it costs no more to build one way or another on paper, I ran to the limit, and piled on some fifty odd stories, with a total height of about 750 ft. Of course it is a beast, and no client in his senses would ever allow an architect to indulge in such vagaries except on paper, but it is good fun, all the same, and some of the problems which have cropped up have been very interesting. Of course I am building the whole thing of brick. That goes without saying. But of course, also, the brick is only 16 ins. thick with the steel skeleton inside of it. To carry out the delusion of persuading myself that this was serious fun, I figured up the wind strains and found that with a pressure of 30 lbs. per square foot on the off side of the building, which measures, by the way, 100 ft. wide and 600 ft. high, the added strains on the opposite columns at the maximum would only amount to about 54 tons, which is pretty inconsiderable when we reflect that each column has about 2,500 tons load upon it. It looms up in great shape and is an example of brick construction which would delight your editorial heart and would strike terror to the souls of our legislators who are trying so hard to slice off all our buildings horizontally to a ridiculously minimum height. — *Subscriber.*

CLUB NEWS.

AT the annual meeting of the T Square Club the following officers were elected for the ensuing year: president, David Knickerbacker Boyd; vice-president, Edgar V. Seeler; secretary, George B. Page; treasurer, Horace H. Burrell.

These officers, together with the following, also elected, comprise the executive committee: Walter Cope, Louis C. Hickman, and Chas. Z. Klauder; house committee: Adin B. Lacey, chairman, Chas. E. Oelschlager, and Percy Ash.

In the regular monthly competition entitled "Farmstead," first mention was awarded Lloyd Titus.

THE ST. LOUIS ARCHITECTURAL CLUB held its regular monthly meeting on Saturday evening, May 1. The club decided to hold an exhibition at the club rooms on May 17 to 22. An interesting talk was given by Mr. Frank A. P. Burford, about Mexico, where he has spent the past year.

THE semiannual meeting of the Detroit Architectural Sketch Club was held April 26, and elected the following officers: Alexander Blumberg, secretary; vice, Edward A. Schilling; directors, Augustus O'Dell and John A. Gillard; vice, Alex. Blumberg and M. S. Willcox.

THE PITTSBURG ARCHITECTURAL CLUB gave its first reception in honor of Prof. Wm. H. Goodyear, April 23, 1897. The club rooms in the Ferguison Block were artistically decorated to suit the occasion, and many architects, artists, and their friends were present. A table covered with hundreds of photographs of medieval Italian churches, taken by Professor Goodyear while abroad, was the center of attraction. He spoke of his discoveries of curves in these churches in a very interesting manner. Save a Bohemian night that was indulged in a short time ago, this was the club's first entertainment.

NEW BOOKS.

MR. RUSSELL STURGIS has rendered a service to the student of art by forming, in a very handy, compact volume, an annotated bibliography of the subject, [1] to which is added a similar annotated list of works on music. It does not claim to be exhaustive; in fact, many of the works, which are chiefly illustrative, are not included in the list, but it mentions all of the well-known works and has a brief description, with price, etc., for each. It forms a very valuable aid to reference.

"HYDRAULIC CEMENT, ITS PROPERTIES, TESTING, AND USE," is the title of a new work by Frederick P. Spalding, Assistant Professor of Civil Engineering at Cornell University, member of the American Society of Civil Engineers.

The pages contain the results of a careful study of the nature and properties of hydraulic cement, and the various methods which have been proposed, or are in use, for testing cement.

The views of the author, as derived from his own observation of the behavior of cement in use or in the laboratory, have been stated without reserve, and free use has been made of the results of available European investigations. The recommendations of the recent commissions appointed in Europe for the study of the methods of testing materials are fully given in so far as they relate to cement. New York, John Wiley & Sons.

1 "Annotated Bibliography of Fine Art: Painting, Sculpture, Architecture, Arts of Decoration and Illustration." By Russell Sturgis. "Music." By Henry Edward Krehbiel. Edited by George Iles. Boston, 146 Franklin Street. Published for the American Library Association Publishing Section by The Library Bureau. 1897. Price, 50 cents in paper; $1.00 in cloth.

Color in its Relation to Architecture.

BY ELMER ELLSWORTH GARNSEY.

THE importance of color in its relation to architecture has not been sufficiently recognized or emphasized among those who teach or practise architectural design; and it is difficult to understand why one of the universal sources of esthetic pleasure, one of the most compliant and resourceful aids to artistic expression, should be so neglected in our day.

It is no new thing, for the best architectural tradition exhibits an intense appreciation of and love for color from the Egyptian to the Renaissance periods, and we find it employed both within and without all sorts of buildings, in all sorts of materials, constructive and applied.

The love of color is a natural instinct; the children of civilization no less than the children of nature are sensitive to the brilliant hues of bird and flower, of sky and sea, and they are equally influenced by the gaiety and joyousness of certain colors, and the saddening hues of others.

Civilization and its refinements have given us a higher appreciation of color, as well as other things, and we crave harmony in its use, just as we demand harmony as well as melody and rhythm in music.

So we need not, and indeed ought not to think of architectural color as a violent laying on or building up of masses of crude and glaring hues, but rather as a skillful blending and refining of surfaces to a more harmonious *ensemble.*

Upon the walls of Egyptian temples were emblazoned the triumphs of kings and the every-day occupations of the people; and the Assyrian palaces bore long processions of men and beasts enduringly pictured on vitrified bricks; the Greek temples were made splendid by painted and gilded sculpture; and all of these, even in their decay, are evidences that the ancient architects considered the color of their buildings as the crowning finish of their work, and perfected this, as other details, as far as their abilities permitted.

It cannot be denied that to our modern ideas the lavish use of strong and even very brilliant color on the exterior walls of buildings and statuary seems barbaric and in questionable taste; yet we are not obliged to go farther in this matter than to experiment with small quantities of color, used with that reserve and caution which should characterize ornamentation of any sort.

We need emancipation in our art and architecture, not that each may follow some original and bizarre method of design, but emancipation from a state of mind which prejudices us against any legitimate means of increasing the efficiency of our artistic expression.

We are not to become archæologists, but we may begin by trying our experiments along the lines which have been followed by others before our time, that we may benefit by their experience.

It will be found that the Greeks used color with a fine appreciation of its value as a means of expression, that they employed cold and warm, light and dark colors to express depth and retreating surfaces, or brilliancy and advancing lines and spaces. The grounds of marble friezes were colored, that the figures of men and horses might receive the greatest distinctness and relief; capitals of columns and moldings were emphasized by strong colors, while shafts of columns and large wall surfaces received simpler and broader treatment in quieter colors.

Recent investigations have shown that these master artists employed polychrome decoration in architecture and sculpture much more generally and liberally than a superficial acquaintance with their ruined monuments and buildings would suggest; certainly to a degree absolutely unknown in modern work.

They sought to express the beautiful in all they attempted, and they touched nothing which they did not beautify. We may therefore be assured that polychromy, as practised by the Greeks, cannot fail to have been as carefully considered, and the results of as great value to us, comparatively, as their other accomplishments in architectural design.

Beneath the deep blue sky of Greece, the association of superb marble and glowing polychrome decoration suggests a most inviting mental picture; one which we may hardly expect to realize, with less responsive materials, beneath a gray and smoke-beclouded canopy. We may add greatly to the charm of our architecture, however, by considering more carefully the colors and textures of the materials of which it is constructed, and seek to combine "ideal color with perfect design."

Students of architecture are taught to think in gray, because, the professors say, the "mass and void" may be best studied and expressed in monochrome, and this seems to be sound doctrine. In the same way the young painter studies from casts in charcoal or crayon; but when the latter has mastered the rudiments of his art, drawing from the round, he is no longer held absolutely to a single gamut of grays and black, he begins to paint in color.

Why should not the student of architecture be taught in the same manner? Study the plan and elevation in gray monotone, but do not stop here; let the color of the composition be considered, and make a separate color study for each problem.

Surely if such a system were carefully followed up, we should not see so many "queer-colored" buildings along our city streets, many of which cause us to wonder if they are brick buildings with stone trimmings, or stone buildings with brick enrichment!

There is no dearth of fine materials at hand in America, quarries are giving up their treasures, and great establishments supply all sorts of brick and terra-cotta, varied in form, texture, and color; but there is a lack of taste on some one's part, or our buildings would be more interesting and creditable examples of architecture.

Our manufacturers of building materials deserve high praise for what they have accomplished, and no age has had so much reason to congratulate itself on intelligent labor successfully applied; and if American architecture does not reflect credit on its creators, no blame can be attached to those who supply the materials from which it takes its form.

The manufacturer supplies the demands made upon him; he does not create the demand; and when architects require brick or terra-cotta of a certain quality or color, a host of skilled men stand ready to execute their wishes. Science becomes the magician, and the whole world of nature is transformed into material ready for the artist's hand.

Color, like taste, is not a matter of simple individual preference or fashion; it is good or bad according to its suitability for given purposes or conditions. It is not for us to say this or that color must be the general tone of your building, for the wishes of the client must be considered, the site and its surroundings must affect our choice; but when the indicated material has been decided upon, and its color fixed, we may so combine it with other materials that it may become harmonious, not only as to its surroundings but to the best artistic traditions as well.

How to study color in its relations to architecture is to study the theory of colors and their relations to each other; and no one has made a more careful and complete analysis of these phenomena than the great Chevreul, a man who died, full of years and honors, a few years ago.

His book on color has been translated into English, and may be had in any of our libraries; but no architect or worker in the allied arts should lack a copy in his own studio. His theory of the harmony of the contrast of complementary colors may be considered the foundation of the study of color harmony; and while it is the most intense and powerful of color combinations, it is as well the simplest and widest in application.

Upon the hypothesis that there are three primary colors, red, blue, and yellow, combinations of any two of these producing the secondaries, violet, green, and orange, he arranges a diagram in which two concentric circles, divided into three segments, display the primaries in the inner and the secondaries in the outer circle.

Thus, red is opposite green, blue is opposed to orange, and yellow is opposite violet. These, then, are the complementary colors, and their opposition forces each to exhibit its greatest brilliancy; and when any two complementaries are employed together or in close proximity, they heighten each other to the maximum degree.

A neutral gray, when placed beside a positive color, apparently gains some of the complementary of that color; and the practical application of this simple demonstration is to be found in the employment of small quantities of positive, primary, or secondary color in conjunction with materials which either lack tone, or whose tone should be modified to some extent.

Interior stonework may be forced to assume a warmth which it does not really possess, by placing near it a mass of colder color, compelling it to partake in some degree of the warm complementary which is opposed to the cold color near it.

Corot's landscapes display a knowledge of this principle, where in a silvery-gray picture one little brilliant spot of red, possibly vermilion, is introduced in a peasant's cap or gown, and instantly the grays become greener by contrast, and the canvas fairly glistens and sparkles. Hide the spot of vermilion and you rob the entire picture of its life and brilliancy.

Delacroix, and, indeed, all the great colorists, play upon this theme, as a musician upon his keys,— from major to minor, and vice versa. And why should not the architect borrow color as well as harmony from those sister arts which so beautifully translate his own?

The employment of complementary contrasts in architectural work is so eminently valuable that it cannot fail to repay the most timid experiment; for we need great masses of quiet color, for grandeur is only possible through massive constructions; yet in and through the gray we may add the touch of color which shall "leaven the whole."

Puvis de Chavannes plays upon the complementaries in the Boston Public Library decorations, and sometimes the individual colors are separated by quite a space of gray. The rich yellow of the Sienna marble demands violet and blue for its completion as a satisfactory color impression, and the painter has carried out a scheme of this character in a wonderful way.

In one panel the pale blue sky at the top forms one point of a triangle, a dull red robe the second, and the yellow marble the third, while the eye of the beholder fuses these three into one harmonious impression.

As an illustration of this principle, certain stone, as Indiana limestone, acquires a decidedly greenish tone when associated with red brick, and the redder the brick, the greener the stone; but if a yellow brick be used in conjunction with the same stone, the latter becomes more purplish in tone. Again, if a purplish-red brick is employed, the yellow tone of the stone is strengthened in like degree.

Where brick is the only material used, it may be varied to any extent by using small quantities of an opposing tone, the kilns furnishing a wide range of yellows, reds, greens, and browns. In constructive color it will be found that large areas demand comparatively low tones of color, but as the areas decrease in size, the strength and brilliancy of color may be increased.

The same rule applies to interior work in marble, wood, or other materials, and the effect of any material may be enhanced or diminished by the judicious association with it of its complementary, or a stronger note of its own color.

A green bronze would be suggested as enrichment for a red marble like Numidian, but we should probably find a bluish patina preferable with the yellowish-red Verona.

The old brownish-red mahogany may be enriched by association with soft green carpets or hangings, but the lighter and yellower mahogany of to-day finds certain blues more agreeable and exciting companions.

Once the habit of *thinking* in color is formed, we find ourselves solving color problems instinctively; and if the attention of students is directed along this line of thought, their later work will show fewer examples of architectural aberration, for how rare are the entirely satisfactory efforts of our architects and painters.

In interiors of public buildings we find motives and orders which were always rendered in color during the best periods of architecture left in a sickly white, with a few lines of gilding as the only relief from inanity. Fancy St. Mark's or the *Capella Palatina* done in white stucco, with a few hair lines of gold carefully picked out in cornice or capital!

Their glory is in the color which bathes dome, wall, and column in golden light. They possess the tone which most of our buildings lack entirely, and which cannot be acquired by one or two tints ostentatiously covering the stucco with an even and wearisome monotone.

If mosaic was employed more generally in our buildings, we should the sooner achieve distinction therein, for it is one of the most satisfactory wall coverings obtainable. Mosaic is never monotonous; it is durable and fadeless, and, besides, it need not be inordinately expensive. There are two columns in the museum at Naples which are beautifully executed in mosaic, and it might be considered appropriate to thus sheathe the steel columns in our modern constructions, making beautiful and suitable enrichment rather than the usual painted plaster covering.

Referring to the use of applied color, we must consider that, as the greater part of our decorative painting must be executed on the wall, the questions of durability and permanence of color become all-important, and as dampness is probably the deadliest enemy of mural painting, it should be carefully excluded.

There is no preventive which compares with an air space between outer and inner walls; and as this means neither more nor less than ordinary furring of all walls and ceilings, it ought not to be as unusual as it now is to find absolutely dry and damp-proof walls, on which the mural painter may place his compositions.

Vitruvius gives an interesting account of the methods in vogue at Rome for the preparation of stucco wall surfaces for painting. Three coats of old slaked lime and sand were to be laid, and then three more coats with pounded white marble instead of the sand, each of these last more finely powdered than its predecessor, and the final coat to be polished until it reflected as a mirror!

Wax was then rubbed over the wall, and a brazier of coals was passed before it, warming the surface of the wall, and causing it to absorb the melted wax. Pigments, either ground in wax or some sort of mineral spirit were used upon this ground, and finally more wax was applied and absorbed, and the surface brought to a high polish. Many experiments have been made to discover some better or rather easier method of mural painting than the old fresco, which has so many disadvantages that it has been practically abandoned by all modern masters; and a modification of the Roman encaustic or hot wax method has been generally adopted by our most experienced men. The wall is prepared with dissolved wax, applied hot or cold, and the pigments are ground in a vehicle consisting of wax, spirits of turpentine, and either a resinous or balsamic "binder"; and as the colors dry quickly, thus permitting the painter to work over or change his composition within a few hours. The method is quite satisfactory for all general work of this character. It is hardly surpassed by the true fresco in brilliancy and not by it in durability, as portraits on wood from the Fayoum and the Pompeian wall paintings attest.

The latter may have been executed in fresco in part, but were usually finished with wax, and it is possible to detect the odor of the wax to this day, on rubbing the surface of the wall with the hand.

In concluding this brief survey of color in its application to architecture, it may not be considered inopportune to refer to the increased interest in mural painting in America, and to prophesy even a greater demand for this form of monumental art among us.

Our painters display, year by year, a higher appreciation of its possibilities, and our architects are giving more attention to its employment, and if the architects could be induced to study color, and the painters to study architecture, we might more confidently predict the triumph of American art.

ARCHITECTURAL RENDERING IN PEN AND INK.

BY D. A. GREGG.

HOW the drawing shall be treated as a whole is a question that should be settled before an ink line is drawn upon an outline submitted for rendering. It is considerable of an item to know how to give proper touch or technique to the work, to know a good line or method for doing the ground, sky, windows, walls, roofs; but failure may, after all, occur with all this skill, for want of knowing how to treat the work as a unit.

A rendering must be designed, studied out in a way, not unlike the designing of a building. As an architect often, by the shape of the lot, has the plan of the proposed building settled and fixed, from which he must erect the exterior design, so a draughtsman similarly has before him a perspective outline upon which he must build his scheme of rendering, which scheme of rendering may be called the general design; the technique of his work being, as it were, the detailing.

The design as a whole, in pictorial effect, is of first importance; the detailing secondary, but good quality in each are necessary for final success.

The rendering scheme is a matter of arrangement of values of black and white; and as every subject is unlike every other, only general principles can be given that will be of any practical use. It is useless to advise any special method for doing the various parts of the work, for what is best in this drawing may not do at all for another. Methods must vary, and effects or values must be moved about as the general scheme may demand.

A drawing may permit several good methods, but usually there is a best way for each particular piece of work.

All subjects should be treated in the largest possible way, broadly, as simply as possible, few effects, the fewer the better, just one if it will permit.

B illustrates this broad treatment. Viewed at a distance, it is like one dab of a brush upon a sheet of white paper. Just one large dark from end to end, from top to bottom. Compare it with E, where starting on the left is a dark, then follows a light, finishing with another dark, — three values instead of the one in B.

F is perhaps as broadly treated as B, as a large light effect. It would be fully as broadly treated if it were not for the value of the fence and the shadow near it. But this dark value is helpful, which goes to show that there are other things to be considered along with breadth, and no principle, however good, can always be carried out unaffected by other important demands.

This principle of breadth is modified and affected by the color of the material of which the building is made. For instance, a white marble building must appear white. Also to get color and contrast in such a drawing, dark buildings at the side are necessary, which introduce a second or third effect, instead of allowing it to remain as one.

Again, if we put one side of the building in shade, as in D, we have a light front and a dark side, — two values, or three, if we count the dark on the left. If foliage is to be shown, and usually it has a dark value, this will most likely make less simple the scheme of the drawing.

It is rarely, therefore, that a subject for rendering, especially if it be a large one, will allow so simple a treatment as B. For small work it is more often possible.

Nor is it necessary that every drawing should be as one dab of the brush. It should only be our aim to comply with its underlying principle of breadth as nearly as the conditions will permit.

A simple treatment is restful. We take it in without mental effort. Large effects are also impressive.

Allied with this broad treatment are certain minor advantages. Illustrators of architecture may assume the right to make their special building as interesting as possible. To make a view of a street is one thing, to make a view of one of the buildings on that street is another.

A may be rightfully called "A View on Steep Hill, Lincoln, Eng." Everything on the street is shown, sidewalks and the ground with its shadows.

B should have another title. "Old Houses on Steep Hill, Lincoln, Eng." In this one you are bound to look at the houses, for that is all there is to be seen, except the distant towers of the Cathedral. By thus omitting needless accessory the interest is centered in the principal object. In A you cannot but observe that the houses are slightly less attractive, because of the detracting interest of even the small amount of sidewalk and ground with its shadows.

Such a wholesale cutting off of accessory is, of course, not always best. In many instances the trees, terraces, and adjoining buildings add to the interest of the picture, in giving variety of form and contrast of color, and if they be rendered with a little less strength than the principal object the effect will be altogether helpful.

There are accessories important, and accessories not important, and this latter kind are best omitted.

Another advantage associated with the simple treatment in B is

one of black and white values. The white sky and ground produce a lively, snappy contrast with the dark of the buildings. The rendering of the buildings, having no competition in sky or ground, show off to their best advantage and fullest value.

D

The simplest thing to do, and it is sometimes the best, and surely always the easiest, is to omit texture entirely, and show shadows only, as in F. The only rendering here that is not a direct shadow is in the windows, but that is, after all, a shadow inside the building on the walls of a room. The necessary drawing of the fence has also the effect or value of a shadow.

This method of shadows only suits some subjects far better than it does this one, in which there is so little of projection or recess that can produce a shadow. Occasionally a building comes in hand for rendering that brings into itself so much color by shadow that more rendering in the way of showing texture or material is quite unnecessary. But it is rarely the case that texture can be altogether omitted. A little, at least, must be shown to properly tell the story.

F with texture omitted perhaps should be called a sketch only. It certainly could hardly be considered a thoroughly finished drawing. But sketches are sometimes as desirable as anything more thorough.

B shows a combined use of shadows and material color — mainly the latter. It is nearly an example of color of material only.

There is a danger connected with the making of a drawing like B which can be dodged somewhat by treating it as in C. The danger is, especially in larger work, of getting a heavy monotonous result through having too much rendering unbroken by fields of light. To show the roof white at once introduces light into the work. In the present instance it seems like using violence to do it, as the rough texture of the roof never would in sunlight permit a white reflection; but in many other instances where the roof is slated or shingled this white reflection is as often seen as not.

E

If you will observe on a sunny day the roofs of buildings and compare their color value with the blue sky, it may be surprising to observe that usually the roof appears the lighter of the two.

At another time of day, with the sun shining upon the roof at another angle, that same roof will appear almost black.

Another scheme which can easily be understood without illustration would be the reverse of C, the roofs dark and walls light, which is a very possible effect when the sun is low, reflecting from the walls, and not from the roofs.

In either case the rendering is simplified — a smaller field of half tone and a larger amount of light. The larger the amount of solid rendering, the more difficult becomes the work.

A drawing must not appear dull and heavy. A sunny, sparkling result should always be sought for.

When the area of rendering is large and close, so much the more need of a sweeping omission of accessory, that the white of sky and ground may relieve the monotony of gray or half tone. Therefore, scheme C or its reverse is a safer one, so far as values go, than B, because of less amount of half tone.

D is simply putting one side of the building in shade. It is not usually best to do this when the shade side is so conspicuously large. If we stood facing the front with a small, sharply vanishing side showing, such a scheme would be the most natural one. As a matter of values it is all right in this instance. But in the rendering of a building where both sides are equally valuable in design both sides should be about equally lighted. A sunlighted surface is always more interesting than one in shade.

E has about as much light in its make-up as D, but it is disposed in a different way. Both sides of the building are supposed to be in light, but the larger and clearest area of light is placed in the middle of the building. It is a possible natural effect, though a rare one. Such a treatment is not the one a camera would discover very

F

often, but it might occur when the sunlight happened to get right of way through a rift in the clouds or the smoke of chimneys. Anyway, it is a method capable of beautiful, artistic effect, and is very often the best one to adopt.

Attention has thus been briefly called to the different treatments which this one subject could bear, which suggestions may be found useful to some of the readers of THE BRICKBUILDER, in work that may come under their hand. They are all based on possible natural effects of light, and shade, and color.

It should be clearly understood that all successful pictorial work is so because it appears natural. The architectural rendering that is the most like to a possible natural appearance is the best one. As all moral teachings can be tested by the standard of the Good Book, so all artistic attempts may be tried by their harmony or lack of it with nature's work in shade, shadow, and color, and correct form.

There need be no poverty in expression with such a varied and abundant store to draw from.

It is best not to heed too much what another learner has to say about these things, and so get them second hand, but go to the original source and learn for one's self. Nevertheless, hints like these I have given may do no harm if their worth is tested by thoughtful experiment.

Fire-proofing Department.

ORIGIN AND HISTORY OF HOLLOW TILE FIRE-PROOF FLOOR CONSTRUCTION.

BY PETER B. WIGHT.

(Continued.)

[In the April issue of THE BRICKBUILDER the last illustration, marked Fig. 17, was used by mistake, and will appear in the present number in its proper place as Fig. 19. The illustration of the first hollow-tile floor arch made by the Wight Fire-proofing Company, and used in the Montauk Block, Chicago, should be Fig. 17, and is here given.]

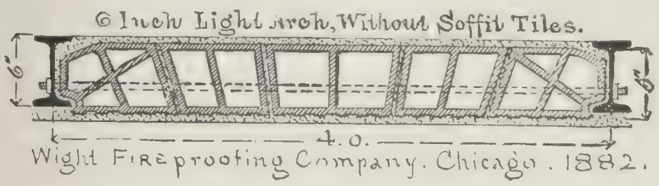


FIG. 17.

THE FIRST USE OF SOFFIT TILES FOR BEAM PROTECTION.

IT is necessary now to retrace our steps over a short space of time to the introduction of a feature which made the flat arch a complete fulfilment of the demand for a continuous fire-proof ceiling and protection for the iron beams as well as a support for the floor, independent of any construction over the beams. Up to 1884 all the flat arches that had been built were practically in the Roux system, and varied from it only in matters of detail. The beams had no protection to the bottom flanges except a plate of cement or common mortar not more than three quarters of an inch thick, gaining support from the slightly dovetailed form of the skew-back tiles. After they were plastered over, in course of time, whether the ceilings were painted or not, the location of the beams could be seen by streaks on the ceilings, and this was especially the case in locations where bituminous coal was used. In 1883, I conceived the idea that the beams could be covered with a shoe of tile on the bottom before setting the arches, and that this shoe could be held temporarily in place by giving the upper side the form of a female dovetail, and filling the joint between the beam and tile with mortar. The whole thing would thus form an extension to the bottom flange of the beam, and the skew-back tile could be made of such form as to surround its edges so that the bottom of the arch would be flush with the bottom of the shoe tile. I patented this invention in 1883, showing its connection with a 9 in. flat webbed arch, an illustration of which is here given (Fig. 18) showing its connection with a 12 in. arch.

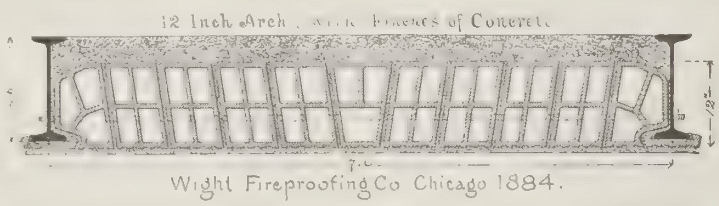


FIG. 18.

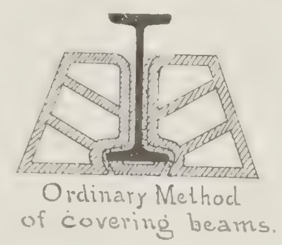


FIG. 19.

These soffit tiles were first used in the main building of the Mutual Life Insurance Company, of New York, on Nassau Street, and that is the first time I believe they were ever used in any building. From then to the close of operations of the Wight Fire-proofing Company, in 1891, they were used with every floor arch built by that company, with only one exception. The holder of the Johnson and Kreischer patent, above described (Fig. 13), brought suit against the Mutual Life Insurance Company for infringement of patent. The judgment was given in his favor except in so far as the use of mortar was concerned, his patent having claimed that the strip was "removable," and not specifying the use of mortar to hold it firmly. It was shown that such a tile had never been actually used in floor construction, in fact, was impracticable under the former patent; consequently the court refused to award damages. I have, therefore, only the satisfaction of knowing that I demonstrated what is practicable in it and have given it to the world. The same plaintiff had previously brought suit against Henry Maurer for infringement of the Balthazar Kreischer patent (Fig. 14), but a verdict was given for the defendant, the main references being the Garcin and Roux patents. In practise it was soon found that it was not necessary to cement the soffit tiles to the beams, but that they could be held in place by the centering until the skew-backs were set in place, and that the bedding of the skew-back filled not only the joint between itself and the soffit tile, but also the joint between the soffit tile and the beam. In places where the arches are removed it is found that the soffit tiles adhere to the beams.

The work on the Mutual Insurance Building was hardly done when others began to use a similar tile under the beam. The first instance that I know of was in the Stillman Apartment House at Cleveland, Ohio, built in 1884–85. There, as in all other cases of work done by imitators, the cheaper method of putting a tile under the beam only the width of its bottom flange was used (Fig. 19.) Here it will be seen that the support from the skew-back is only half as great as where the soffit tile is also dovetailed at the top. The only variation I ever made from this method was in the case of the Phœnix (now Western Union) Building, Chicago, where the bottoms of the arches were 3 ins. below the beams, and the soffit tiles were made as complete hollow tiles. The arches were 10 ins., having 7 ins. rise above the bottoms of the beams. The flat soffit tile, with a slight recess on the top to afford an air space, is still generally employed by all contractors for beam protection, with various kinds of arches. Some other methods were tried, but have gone out of use. Henry Maurer, of New York, still makes a skew-back with an arm extending half way across the bottom of the beam, having a small hollow space. Fig. 20 shows the ordinary method of protecting the bottoms of the beams as used by the Pioneer Fire-proof Construction Company, of Chicago, when side pressure hard tiles are employed. The arch tiles are 10 ins. deep.

10-inch Web Tile Floor Arch Weight, 40 pounds per square foot.

FIG. 20.

INTRODUCTION OF THE END PRESSURE SYSTEM.

It was not until 1890 that any advance had been made in the construction of hollow-tile floor arches over the methods used in New York, of which Maurer's was a good example, and those of the Wight Fire-proofing Company and Pioneer Fire-proof Construction Company, of Chicago. A great deal of work had been done by others which resembled these methods, and side-pressure porous tile arches had been made and used in several buildings in Kansas City as well as Chicago. Those used in Chicago were made of a light brick clay from Lake Calumet, with an admixture of a small quantity of fire-clay from Brazil, Ind. The Kansas City material was made of the very inferior loamy red clay of which the hills of that city are composed, and was about the worst material from which porous terra-cotta could be made, both for constructive and fire-resisting purposes. Its use also involved the manufacturers in great loss from breakage in the course of handling and setting. Mr. Thomas A. Lee was

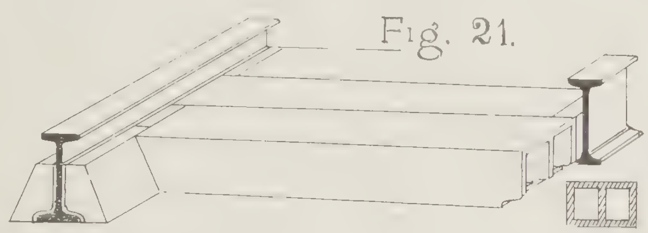
then the superintendent and engineer of the Kansas City Company. When he obtained the contract for fire-proofing the United States Government Building at Denver, he determined to use a white semi-fire-clay from Hobart, Ind., not far from Chicago, for the manufacture of his porous terra-cotta, this having been used successfully for side-pressure floor arch blocks at Chicago in the Metropole Hotel. But instead of using side-pressure voussoirs, he made all the tiles from one die, the section being a square of 9 by 9 ins. with cross webs in both directions. The tiles had four square holes, and the thickness of all the walls and webs was about 1 in. These were cut, before drying and burning, into skew-backs and voussoirs, and were set in courses from beam to beam, so that no joints were broken; but in all cases four joints would come together at one point. These, I believe, were the first end-pressure arches ever set in a building, and the same method, but with tiles of a different cross section, was used by him in the Broadway Theater Building at Denver. I have always thought, though I am not certain, that Mr. Lee determined to set his porous tile arches in this way at Denver on account of the difficulties that he encountered with the use of inferior porous terra-cotta at Kansas City. In any case, I think that he is entitled to the credit of having first used end-pressure arches successfully in an entire building. But the Kansas City Company had been working under patents of the International Terra-Cotta Lumber Company, which had already experimented with arches made by taking a long piece of rectangular porous terra-cotta, cutting it into voussoirs and setting them together in a flat arch.

The principle of the end-pressure arch had, however, been patented long before this. In addition to the use of end-pressure tiles for segment arches, as heretofore described as invented by Joseph Bunnett in 1858, a patent was issued in this country to Leonard F. Beckwith, of New York, for an end-pressure flat hollow arch in two pieces, in 1879.

I reproduce an illustration of this system from the *Patent Office Gazette* (Fig. 21).

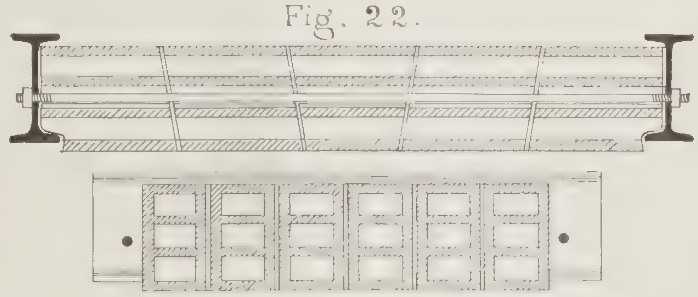
Mr. Beckwith made his arch in two pieces, using one long hollow tile and one solid skew-back. The end of the hollow tile resting on the beam was cut to fit it, and the other end was beveled to fit the skew-back, which also had the shape of the beam on its bearing side. He alternated the position of the skew-back at every other course, but each course was an independent structure as now used in all end-pressure arches.

Fig. 21.



L. F Beckwith's Patent End Pressure Arch. 1879

Fig. 22.



Cross and Longitudinal Sections of Thomas A. Lee's End Pressure Porous Terra-Cotta Arch, Tested at Denver, December 1890.

I have never seen these arches put into practical use. This was not even the earliest patent touching the principle of the end-pressure arch. In 1875, a patent was issued to Levi T. Scofield, of Cleveland, O., for hollow floor arch tiles between I beams all in one piece. They were shown to be either flat or in segment form, and of many different sections, but in all, the holes ran from beam to beam.

On account of the difficulty in burning long tiles this system was never used to any extent for floors, but where ⊥ irons were used not more than two feet from centers, a similar tile came in use, which was called "book tile," on account of its having the outer section of a book, so as to lock the tiles together. Mr. Scofield's patent did not cover the tongue and groove shape at the edges, and book tiles were never patented, but were extensively used long before end-pressure arches made of voussoirs.

THE DENVER TESTS.

The general adoption of end-pressure arches is very recent, and followed soon after the extensive tests made by Andrews, Jaques & Rantoul, architects, before the erection of the Equitable Building at Denver. These tests have been described and commented upon in THE BRICKBUILDER (January and February, 1895,) by Mr. George Hill. They were suggested by Mr. Thomas A. Lee, who had bid for the fire-proof work on the building in competition with the two best-known fire-proofing companies of Chicago, and was the highest bidder. His tender was for porous terra-cotta floor arches, and his samples were made at Hobart, Ind., where, I believe, most of the material for the building was subsequently manufactured. He challenged the other two bidders, both of whom made side-pressure arches of dense fire-clay for strength of material, and fire-proof qualities. A section of his sample arch which was subjected to all the tests is here given (Fig. 22).

The tests for strength on all the arches were for dead weight and smashing. Those for fire resistance were for a continuous fire until destroyed, and for fire alternating with water until destroyed. It is needless to say that these were crucial tests, and it should be added that they were conducted with perfect fairness to all parties. They demonstrated the superiority of Mr. Lee's material and construction to the others in every case, and yet the published results were calculated to be very misleading to architects and the users of hollow tile floor construction who did not study the reports carefully. I entirely agree with the criticisms of Mr. Hill. But it should be added that the publication of such tests without comments, especially when they were tests to the point of destruction in all cases, is calculated to convey the erroneous impression that the two systems most easily destroyed were worthless, and the survivor the only good one. As a matter of fact, the only tests that demonstrated anything useful were the still-load tests for strength and the heat tests during the first three hours. In the still-load test the arch of the Wight Fire-proofing Company broke at exactly 1,000 lbs. per superficial foot, adding the weight of sand and box to that of the pig iron, while the report was so drawn as to imply that the weight was only from the pig iron. This is exactly the extreme weight they were guaranteed to carry, and to which they had been repeatedly tested in floors of buildings. The Pioneer Arch broke at 651 lbs. per superficial foot, but it was admitted that the sample was defective and not up to the standard of their work. So, also, with the heat tests. That for continuous fire lasted twenty-four hours in each case, and there was no way of making a record of the condition of the samples after three hours, which is about as long as they would ever have to last in any building. As for smashing tests, all kinds of material are continuously being tested by falling bodies in new buildings, and it is well known how they are affected.

The tests demonstrated that porous tiles were more fire-proof than hollow tiles, and that end-pressure arches are stronger under the same conditions than side-pressure arches, but did not demonstrate that hollow fire-clay tiles would not stop the progress of an actual fire, nor that side-pressure arches, as usually made, were not strong enough for practical use in all classes of floors.

(*To be continued.*)

Mortar and Concrete.

AMERICAN CEMENT.

BY URIAH CUMMINGS.

CHAPTER VII.—(*Continued.*)

CEMENT TESTING.

HENRY REID, in his work on "Portland Cement," London, 1877, page 315, says: "The presence of free lime thus unconverted is now frequently due to an over-dose of carbonate of lime in the cement mixture to enable it to pass successfully the modern onerous tests."

From that time until to-day the demand for higher tests has been continuous and more burdensome, and the manufacturer has not scrupled to employ any and every means within his power to accomplish the required results. He has to do it or retire from the field.

And thus, by an unfortunate misinterpretation of the readings of the tensile strain-testing machine, in the early days of its existence, the opinions then formed have passed current as sound and unquestioned through all the subsequent years.

So strong and deep seated is the belief to-day in the reliability of the testing machine, that a person who cares to be considered as "up to date" must express no doubt as to its infallibility.

An ideal hydraulic cement, as already stated, can be produced by what is known as the Portland process.

It would consist in a selection of the raw materials which were found to be best adapted for the purpose (special care being taken, at least, as to the quality of the clay), and these to be thoroughly and finely commingled in correct proportions, then calcined to a mild clinker, sufficiently vitrified to produce the desired weight, and then ground exceedingly fine.

Such a cement would test only about half as high as the present so-called Portlands, yet it would be an ideal cement.

It could not be excelled, and could be equaled only by a rock cement having its constituent parts present in exact chemical proportions.

It is only through the engineer that any improvement may be expected. He alone is entitled to the doubtful distinction of bringing about the change from the slow-setting pasty Portlands of twenty-five or thirty years ago to the harsh, high short-time testing Portlands of to-day.

It is neither pertinent nor sound to reason that, because the Portlands used twenty-five or more years ago may be in good condition to-day, the Portlands of the present are worthy of the utmost confidence, for every person at all conversant with the facts knows that those earlier Portland cements tested but about half as high in one, seven, thirty, and ninety day tests as do the Portlands now on the market.

If an artificial cement of a pasty consistency should test 80 lbs. in one day, and 175 lbs. at seven days, 300 lbs. at six months, 600 lbs. at one year, 1,000 lbs. at two years, and 1,200 lbs. at five years, and should be found at that age to be tough and stone-like in its character, can any one for a moment doubt that such a cement would be infinitely superior to the harsh, high short-time testing cements of to-day?

Is it not worth while to reflect that for every one year that harsh cements have been in use, those of a pasty character have been in use fifty years?

Is it difficult to understand that it is only the pasty cements that eventually assume a stone-like character, while those that are harsh inevitably become glassy?

It is well known to every manufacturer that the latter class is much more expensive to produce, but the manufacturer has no alternative. He must produce such grades of cement as the engineers demand.

It is to the engineers, therefore, as has already been stated, that any improvement may be looked for, and the only improvement needed, with respect to artificial cements, is to get back to the sensible Portlands of thirty years ago.

Let the engineer stipulate that cements shall not test below or above certain fixed limits, and there will be an end to this doctoring and drugging of the artificial cements, which is resorted to simply and solely for the purpose of meeting arbitrary and unreasonable requirements.

The following table of tests of English Portland Cements by Reginald Empson Middleton, M. Inst. C. E., was printed in *Engineer*, London, Vol. 65, p. 279, April 6, 1888.

The figures given represent the average strength in pounds per square inch, in tensile strain, and the ages in days of the briquettes when broken.

No.	Days.	Pounds.	Days.	Pounds.	Days.	Pounds.	Per cent. of Loss or Gain.	
1	7	258	942	440	1325	550	Gain.	113.
2	7	320	900	635	1283	577	Gain.	75.
3	7	371	982	560	1365	599	Gain.	61.
4	7	419	1040	435	1423	492	Gain.	18.
5	7	479	1088	542	1471	551	Gain.	15.
6	7	534	858	545	1241	526	Loss.	1.5

This table discloses the fact that artificial cements which at seven days test from 250 to 350 lbs. show higher ultimate results than those which at seven days test 400 to 600 lbs.

The following quotation from the "Transactions of the German Association of Cement Makers" discloses either a deplorable lack of common honesty or a desperate attempt at fulfilling the severe requirements of engineers. "In order to obtain the best results (?) the amount of plaster of Paris used must be proportionately increased in accordance with the quantity of ground slag employed." Presuming it to be a case of necessity rather than a lack of common honesty, what a commentary on the straits to which the producers are reduced to meet the requirements of engineers, knowing, as all manufacturers do know, that plaster of Paris is in no sense hydraulic, although it tests neat as high as 250 lbs. per square inch in tensile strain in twenty-four hours.

The time must surely come when it will be well understood that any and all schemes of hot-house forcing, for the purpose of obtaining high seven-day tests, constitute an unnatural interference with the crystallization of true silicates, and are therefore a serious damage to their most desirable qualities of endurance.

Verily it is the pace that kills, and even when applied to hydraulic cements, there is, if we may be permitted to employ it, no truer saying than "Soon ripe, soon rotten."

For hydraulic purposes there is no known substance that can in any way aid or improve the quality of pure unadulterated hydraulic silicates, when left to crystallize in their own natural way.

THE BOILING TEST.

During the past few years it has become quite the fashion to boil samples of cement in order to test their qualities.

If one brand sustains the test without serious results it is considered superior to others which fall down during the boiling. This is about as wise and logical a conclusion as that arrived at by some of our good old Puritan fathers during the witchcraft craze.

The witch, being thrown into a pond, if she went to the bottom and stayed there, was considered innocent. But if she managed to float, she was deemed to be possessed of the devil, and was then forced to the bottom on general principles.

By the boiling test, many of our very best brands of cement are condemned.

It is safe to assert that of the more than one hundred and fifty million barrels of American Rock cements used in all the great en-

gineering works throughout the country during the past fifty years, and with no evidences of failure, not 1 per cent. would have sustained the boiling test.

A cement, whether natural or artificial, that will crystallize so rapidly as to sustain the boiling test, ought to be looked upon with suspicion, as it is either naturally too quick setting, or is too fresh and lacking in proper seasoning.

FREEZING TEST.

The many experiments that have been made by different authorities in the freezing of green cement samples would seem to indicate that Portland cement mortar will sustain severe freezing without appreciable disturbance of the exposed surfaces, but it suffers in loss of strength in some cases as much as 50 per cent.

While the Rock cement mortars will show disintegration to the extent of ¼ to ½ in. on the exposed surfaces, yet the portions not disintegrated are shown to have sustained no loss in strength, and in some instances the strength is above the normal.

A series of tests made by the author, the results of which are herewith tabulated, differ somewhat from those of other writers, resulting, no doubt, from having experimented with different brands of cement.

All of the briquettes were given one day in air and six days in water, those in the second column being placed in water and set outside, where they were soon frozen, and so remained in solid ice, until thawed out and broken at the end of the seventh day.

All of the briquettes represented in the second column, after being thawed out, were shown to have lost equally in area, by scale and disintegration to the depth of ⅛ in. on all sides.

There was no appreciable difference in the losses, the Portlands having suffered equally, in that respect, with the Rock cements.

The figures in the second column show the actual breaking strain of the frozen briquettes, but it will be borne in mind that the areas of these briquettes were greatly lessened by freezing; therefore the percentage of loss in strength, as shown in the third column, represents the loss without regard to actual areas.

The fourth column represents the strength of the samples in the second column when calculated at 1 full square inch, or equal in area to the samples in the first colunm.

The fifth column represents gain or loss in strength of the frozen samples, with equal areas of the unfrozen ones.

All of the briquettes were gauged neat by the same person, and were treated alike as to plasticity and temperature.

TABLE OF TESTS OF THE RELATIVE STRENGTH OF FROZEN AND UNFROZEN SAMPLES OF THE SAME CEMENT.

No. of Column.	1	2	3	4	5	
Kinds of Cement.	Not Frozen.	Frozen.	Per cent. of loss by freezing.	Per square inch of the frozen samples.	Per cent. of loss or gain by freezing, of equal areas.	
Medium Burned Rock Cement.	138	135	2.17	194	Gain.	40
Hard Burned Rock Cement.	226	225	0.44	323	Gain.	43
Slow Setting Portland.	388	280	27.83	402	Gain.	04
Medium Setting Portland.	419	292	30.31	419	Gain.	00
Quick Setting Portland.	433	255	41.11	366	Loss.	15

There is a surprising gain in strength of the Rock cements by freezing.

With the Portlands, the slow and medium setting samples held their own, while the higher testing Portland, under ordinary rules, lost 15 per cent. in strength of equal areas by freezing.

It is not good practise to use any kind of cement in cold weather, especially when it freezes during the night and thaws during the day, and should be avoided whenever possible.

NOTE.—Mr. Cummings's series on American Cements will be concluded in the July number of THE BRICKBUILDER.

LIME, HYDRAULIC CEMENT, MORTAR, AND CONCRETE. III.

BY CLIFFORD RICHARDSON.

LIME MORTAR.

MORTAR is a mixture of some cementing material with sand. Lime mortar is composed of lime paste and sand, with the addition, for certain parts of plastering, of hair and similar bonding material.

NECESSITY OF SAND IN MORTAR.—Good cream of lime might be used alone as cement, as it hardens on exposure to the air by drying, were it not that, under these conditions, it shrinks and cracks very badly. It is, therefore, customary, both on this account and for economy, to temper it with sand. This should be clean, sharp, and rather coarse for masonry, finer for plastering. When discussing hydraulic mortars and concretes there will be occasion for a further consideration of sand and its qualities and proper use.

PROPORTION OF SAND TO LIME.—A mortar made of lime paste should, theoretically, contain so much sand that the cream of lime will more than fill the voids, that is to say, the volume of the mortar should be greater than that of the sand. In fact it is necessary that it should considerably more than fill them in order to thoroughly coat each particle and provide for shrinkage. If too much sand is present there is not sufficient cementing material to make a firm bond, while on the other hand, if there is too little the mortar will tend to shrink and crack on drying. If too little lime is used the deficiency must be made up with water, that is to say, the paste is made very thin.

In ordinary sands the voids are from 30 to 40 per cent. of the volume of the sand. With sand, having 40 per cent., such as that which is used for the best lime mortar, 1 volume of paste would fill the voids in 2.5 volumes of sand with no excess. As a matter of fact, practice leads to the addition of only from 1.25 to 2 volumes of sand to 1 of paste which, when the caustic lime yields 2.5 volumes of paste, means 3 to 5 volumes of sand to 1 measured volume of caustic lime. In this way a plastic mortar and one that will not crack in drying is made. With fat lime and sharp sand 3 volumes of sand to 1 of lime forms a rich mortar and these proportions are often required in the best specifications. The greater part of the mortar used in ordinary brickwork is, however, made with 5 volumes of sand, or more, and is probably satisfactory.

Illustrating the results of the variation in the proportions of lime, water, and sand in mortars, the following original experiments have been made:—

MORTAR EXPERIMENTS.

Composition and Physical Properties of the Caustic Lime.

Loss on ignition, water, etc.	1.0
Insoluble silica and silicates	1.2
Alumina and iron oxide	.8
Magnesia	.6
Lime	95.6
	99.2
Volume weight of a cubic foot including voids	60 lbs.
Voids	44
Density of lump	1.52

No. of Experiment.	1	2	3	4	5
Weight of lime used	1,000	1,000	1,000	1,000	1,000
Weight of water to slake	1,000	2,000	2,500	3,000	4,000
Weight of water for paste	1,000	500	none	none	none
Volume of water to one of lime	2.	2.5	2.5	3.	4.
Volume of paste	2,000	2,560	2,712	3,120	4,120
Weight of paste	2,720	3,280	3,392	3,880	4,850
Density of paste	1.36	1.28	1.25	1.24	1.17
Characteristics of Paste	Thick	Thick	Medium	Thin	Very thin
Volume of sand, moist	2,000	3,000	5,000	7,100	14,360
Weight of sand	3,000	4,500	7,500	10,080	20,600
Volume of sand to lime	2.	3.	5.	7.1	14.4
Volume of sand to paste	1.	1.2	1.8	2 6	3.5
Volume of mortar	3,320	4,400	5,840	7,200	13,500
Weight of mortar	5,740	7,760	10,650	13,960	25,450
Density of mortar	1.73	1.75	1.82	1.94	1.88
Consistency of mortar	Thick	Medium	Medium	Sloppy	Very sloppy
Dries	Cracks	Dries without shrinking.			

PERCENTAGE COMPOSITION.

Water	30.0	29.3	22.5	20.7	15.1
Sand	52.6	67.9	68.1	72.2	82.0
Lime	17.4	12.8	9.4	7.1	3.9
	100 0	100.0	100.0	100.0	100.0
Relation of water to lime	1.7	2.3	2 4	2.9	3.9

COMPOSITION OF DRY MORTARS.

No. of experiment.	1	2	3	4	5
Water of hydration	7.4	4.8	3.7	2.8	1.5
Sand	70.0	81.1	84.6	88.5	95.0
Lime	22.6	15.1	11.7	8.7	4.5
Weight per cubic foot dry, lbs.	98.	99.	101.	108.	111.
Tensile strength, lbs. per sq. in. when dry	40–16.	36.	38.	40.	30.
Crushing strength, lbs. per sq. in. when dry	95			97	85

The experiments, it will be noticed, were carried out with a pure and fat lime. The sand in use was not very coarse, and had 40 per cent. of voids. From the results the following conclusions may be drawn:—

SLAKING. — Slaking with a volume of water equal to the measured volume of the lime, with 44 per cent. of voids, or with a weight of water equal to the weight of the lime, gives a volume of paste, after the addition of another volume of water, equal to that of the water used, only. This paste is very thick.

Slaking with two volumes of water, with the addition of half a volume, after slaking is finished, making 2.5 volumes of water in the paste, gives 2.56 volumes of paste which is thick and rich.

Slaking with 2.5 volumes of water added all at once gives 2.71 volumes of thick paste suitable for good mortar.

Slaking with 3. volumes of water added at once gives 3.12 volumes *of* thin paste.

Slaking with 4. volumes in the same way yields 4.12 volumes which is too thin to be of value.

It appears, then, that slaking with 2.5 volumes of water added at once is the most advantageous method of procedure, and that but a small departure from these proportions on either side will result in forming a less satisfactory paste.

Of course with poorer limes much smaller volumes of water should be used.

DENSITY. — The density of the paste naturally decreases with the increase of water it contains.

VOLUME OF SAND FOR MORTAR. — If but twice the volume of the lime is added to the paste in the form of sand, the resulting mortar is too rich. It contracts and cracks on drying. Three volumes of sand make a very rich and satisfactory mortar such as should be used for laying up fronts and pointing. Five volumes form a mortar good enough for ordinary brick masonry where not exposed to moisture, while greater amounts of sand furnish mortars which are very porous, but serve for cheap work in absolutely dry situations.

DENSITY OF THE MORTARS. — The density of these mortars is, of course, proportionate to the amount of sand they contain. Their porosity is larger the more water the paste contains.

VOLUME OF MORTARS. — With a small amount of sand the volume of the mortar is, where twice the volume of the lime is sand, 66 per cent. more than the volume of the sand; where the volumes of the sand is three times the lime, 46 per cent. more; where 5 volumes, 17 per cent.: with 7 volumes the mortar is less in volume than that of the damp sand owing to its closer compaction.

The amount of water in the paste plays a prominent part in the relation of the volume of mortar to the volume of sand and to the amount of sand which can be added to any paste.

COMPOSITION OF WET MORTARS. — Calculation shows that these varied mortars contain from 30 to 15 per cent. by weight of water or from 17 to 3.9 per cent. of lime, but the relation of water to lime increases with diminution of the amount of lime, that is to say, with the increase of sand, from 1.7 in the richest mortar to 3.9 times as much water as lime in the poorest mortar with the thinnest cream. These figures show why the richest mortar contracts the most on drying from loss of the largest amount of water, and that the poorest mortars, although not having as large a per cent. by weight of water still have not enough lime to form proper cement.

COMPOSITION OF DRY MORTAR. — The dry mortars contain from 22.6 to 4.5 per cent. of lime, but as the two extremes of combination would never be used in practice, it appears that mortars as ordinarily mixed may contain from 15 to 8 per cent. of lime. This corresponds to the results obtained by analysis of many mortars actually employed in masonry.

STRENGTH OF DRY MORTAR. — The set of mortars acquired by simply drying out gives them a tensile strength of from thirty to forty pounds per section of 1 sq. in., and a crushing strength of about 85 to 95 in 2 in. sq. section. There is not such a difference between the different kinds of mortars at this stage, but with age there would be but little increase in strength with the poorer ones. The physical properties of the latter are also against them as they cannot resist moisture.

Professor Smith's tests, given in the January number of THE BRICKBUILDER, show also that with a diminution in the cross section of the mortar there is an increase in the strength per square inch of section. This is due to the liability of shrinkage cracks in tests pieces made with larger cross sections.

GENERAL CONCLUSIONS. — It appears that fat limes should be slaked with 2.5 volumes of water, added at once in a closed box, to obtain the best and largest amount of good paste; that with this, three times the volume of the lime in the shape of moist sand may be mixed for fine work, such as pointing, plastering, and in places exposed to dampness, and that 5 volumes of sand is not too much for ordinary brickwork.

The amount of mortar which a barrel of lime, of average weight, under the same conditions as in the experiments, would yield is,

Parts sand	Parts water	Cubic feet.
3	2.5	16.5
4	2.5	20.6
5	2.5	24.8

or, 4 cu. ft. of lime with 2.5 parts water, and 4 volumes of sand would yield 22 cu. ft. of mortar, which, according to authorities, is sufficient to lay one thousand brick in ordinary brickwork with coarsely drawn joints. With more compact work one barrel of lime will lay one thousand bricks. A barrel of poor or magnesian lime will not yield more than three quarters of these quantities.

AMENDMENTS TO LIME MORTAR.

Lime mortar, made of ordinary rich lime, is not suited for masonry where it is exposed to water, dampness, or to the absorption of water by capillarity from the soil. The hardest lime mortar will absorb 15 to 25 per cent. of its volume of water. If hydraulic cement cannot be substituted for it, on the score of economy, a certain degree of improvement may be made in the mortar by mixing it with finely ground brick-dust or burnt clay, which yield the necessary silica to make it somewhat hydraulic and less porous; or a certain portion of the lime, one third, for instance, may be replaced by hydraulic cement.

This is seldom done, as it is cheaper in the end to use cement alone.

EFFECT OF FROST ON LIME MORTAR. — The most thorough experiments of Tetmaier show that lime mortar cannot be used at temperatures below freezing, especially with porous materials, and attain any bond. No additions, such as salt, soda, glycerine, or sugar will prevent lime mortar, when frozen for any length of time, from becoming a friable material.

MIXING MORTAR.

Mortar can be mixed by hand or machinery. The latter is of course preferable. When done by hand, as is the common custom, the operation should be carried on in a closed box, or on a surface through which water cannot escape, and with suitable walls of sand. Machine mixing is much more thorough than that done by hand, and is coming into vogue rapidly in our larger cities where there is such a use of mortar as to make it an economy to prepare it on a large scale. Such mortar is more regular in composition than hand made. All the material can be accurately gauged and weighed, which is most desirable.

SETTING OF LIME MORTAR.

The setting of lime mortar is the result of three distinct processes which, however, may all go on more or less simultaneously. First, it dries out and becomes firm. Second, during this operation, the calcic hydrate, which is in solution in the water of which the mortar is made, crystallizes and binds the mass together. Hydrate of lime is soluble in 831 parts of water at 78 degs. F.; in 759 parts at 32 degs., and in 1136 parts at 140 degs. Third, as the per cent. of water in the mortar is reduced and reaches 5 per cent., carbonic acid begins to be absorbed from the atmosphere. If the mortar contains more than 5 per cent. this absorption does not go on. While the mortar contains as much as 0.7 per cent. the absorption continues. The resulting carbonate probably unites with the hydrate of lime to form a subcarbonate, which causes the mortar to attain a harder set, and this may finally be converted to carbonate. The mere drying out of mortar, our tests have shown, is sufficient to enable it to resist the pressure of masonry, while the further setting furnishes the necessary bond.

There is also supposed to be a formation of lime silicate in the course of setting. The evidence in favor of this has been obtained by German investigators from the analyses of very old mortars. Some of these analyses have been collected by Feichtinger, and are of interest.

	1	2	3	4	5	6	7
Lime	23.52	17.40	18.26	45.70	13.27	22.02	14.42
Magnesia	8.50	9.92	5.06	1.00	0.86	1.33	0.04
Carbonic Acid	16.24	10.30	18.94	37.00	11.31	19.59	11.37
Silica, Soluble	10.40	3.98	1.11	——	trace	0.22	0.40
Alumina	2.56	3.42	1.90	2.64	1.72	1.90	trace
Iron Oxide	1.56	4.25	1.90	0.92	1.72	1.90	trace
Water	4.48	5.49	3.31	0.36	2.34	3.05	0.92
Sand	32.50	43.30	51.52	12.06	70.50	51.89	72.50
	99.76	100.06	100.00	99.68	100.00	100.00	99.80
Carbonic Acid calculated from lime and magnesia	27.83	23.68	20.3	37.00	11.36	18.74	11.37

1. Mortar from Vienna, 662 years old.
2. " " " 303 " "
3. " " " 50 " "
4. Athenian Mortar, classical times.
5. Munich " recent.
6. " " "
7. Old Roman, Yarmouth, England.

It appears more plausible that the soluble silica found in these mortars was derived from silica contained in the limestone from which the lime was derived, and which was rendered soluble in the process of burning by combining with lime, than that it was due to any combination of the lime of the mortar with the silica of the hard quartz grains of sand, which seems highly improbable. In these old mortars the amount of carbonic acid is high, and in several cases it is sufficient in amount to have converted the lime and magnesia completely to carbonate, although the percentage of these bases is in most cases much greater than good practice demands.

The Masons' Department.

THE ARCHITECT AND CONTRACTOR.

BY THOMAS A. FOX.

IN CONCLUSION.

IN closing this series of articles which have been intended to show briefly the relations, both as they are and as they should be, between the architect and contractor, it is desirable to emphasize the fact, to which allusion has already been made, that the way to overcome much of the friction and many of the misunderstandings which now exist is to bring about more intimate relations between the representative organizations of the architects and the builders. In almost every city of any considerable size throughout the country we now find a local society of architects, usually a chapter of the American Institute and a Master Builders' Association, generally connected with the national organization. While these two parent bodies have considered, from time to time, various matters of mutual interest, and have conjointly framed and issued the uniform contract which has done more than any other one thing to bring about harmonious practice in this important particular, at the same time there are many matters of detail in which local customs figure to such an extent that action by the national bodies is undesirable, which could be easily adjusted by conferences between the local organizations. There is little doubt that, under ordinary conditions, the average architect considers the average contractor a more or less unprincipled individual, who selfishly guards his own personal interests at the expense of every one else, and it is also true that this feeling is reciprocal on the part of the builder. But this condition of things fortunately exists only when the parties, as the saying is, deal with each other at arm's length. Let a body of men, representing the architects and builders, sit around a table and discuss, in a liberal and broad-minded way, the matters which have been the result of innumerable controversies and more or less hard feeling in the past, and each would be surprised to find how quickly and satisfactorily many of the contested points could be settled. The Boston Society of Architects, which justly prides itself as being one of the leaders in its sphere on such matters, at a recent meeting ordered its executive committee to meet the representatives of the Master Builders' Association, to consider in general the matters of mutual interest to both bodies. While it is too soon to predict in detail what the outcome of such a conference will be, it is safe to say that this action promises to be the entering wedge which may lead, eventually, to an agreement which will correct at least some of the abuses which exist on each side. Reforms usually commence from without, that is to say, while the architects on the one hand, and the builders on the other, may be aware that certain improper practises exist, there will be little hope of their being corrected until attention is called to them, and possibly some pressure brought to bear by those who suffer from the present condition of affairs; and the simplest and easiest way to accomplish the desired result is to bring the interested parties face to face, where they may listen to a frank discussion of the matter at hand. For those who have made a study of these questions it cannot be claimed that this series of articles has presented any new facts or suggestions, for such has not been the intention; the object in writing on the relations between architect and contractor has been simply to point out the fact that there is at the present time more or less friction between these two allied interests; that while much of the trouble is due to unavoidable conditions, under which much of the work is undertaken and carried out, yet at the same time many of the abuses are such that they could be corrected by the intelligent and united action of the architects on the one hand, and the builders on the other. The means for accomplishing such a result are at hand in the societies of architects and associations of builders, all that is necessary being to bring the representatives of each together; and if

this can be accomplished, as it already promises to be, we shall, no doubt, see in the near future the same improvement in the ethics between these two organizations as we have witnessed within individual associations themselves.

BRICK JOINTS.

THROUGH the efforts of the architects and manufacturers the brick industry has, of late years, shown a wonderful development, for it is but a comparatively short time since there was practically but one shape and color, and the only variation to be had was in the different degrees of finish. During the period when the pressed brick was in favor, it was unquestionably the desire of both the architect and the mason to avoid, so far as possible, all appearance of texture in a face wall; the bricks were made as smooth and regular as possible. They were bonded with "cut" headers, so as not to disturb the regularity of the courses, and the joints were made as fine and narrow as was possible, one of the essential qualifications of a first-class face brick layer being the ability to make the joints as narrow and inconspicuous as possible. Such work was at first laid in common mortar, made with fine sand, which allowed the bricks to be laid very close, but later the desire to have the joint still less prominent led to the practise of putting such coloring matter in the mortar as would bring it to the same tone as the brick. This practically obliterated the joint, and made a wall of a smooth, slippery, and, as it has sometimes been called, "licked" surface.

This kind of masonry necessarily lacked two essentials of most good architecture,— texture, and a straightforward recognition of the materials employed and the method of using them. Now, the construction of a brick wall naturally consists in laying courses of bricks one on top of the other, with a layer of mortar between each one, and it is consequently apparent that if we are to use our materials honestly, the joint of a brick wall should be recognized as an architectural feature just as much as the bricks themselves; and so soon as this is done we begin to get a surface with texture. It has been difficult to convince the mechanic, who was taught, when learning his trade, to obliterate so far as possible all trace of the joint, that comparatively wide joints of mortar of a different color from the bricks themselves could make a workman-like-looking job, and it is often hard work to bring a man who has served his time to sacrifice his principles so far as to follow the architect's directions, and lay a wall where the mortar joint is conspicuous, both on account of its width and color; but in many instances the mechanic has freely admitted, when the work was finished and cleaned down, that after all it had a certain merit and pleasing appearance, which was lacking in that which was done in the old way.

Besides recognizing the joint by means of color, it is also oftentimes desirable to use a greater width, particularly in the bed joints, which necessitates the use of a much coarser sand than was formerly employed, so the bricks will not only stand up, but also stay in place. And if such work is laid in wet weather and a hard and non-absorbent brick is used, it requires some skill to keep the wall plumb and true, but this difficulty can be overcome by the exercise of a little care and attention.

While the cement or coloring matter, which may be mixed with it control to a considerable degree the color of the mortar, nevertheless, the sand has an appreciable effect, and where it is desired to get a light-colored joint, the best sand for the purpose is a coarse, white beach sand, the only objection to it being that it is not as sharp as some bank sands, but this fact is not of sufficient importance, however, to interfere with its use. It was formerly quite generally supposed that the presence of salt in mortar was detrimental to its strength; it has been proved of late, however, that just as good mortar can be made with salt water as with fresh; and the government, on its most important works, as sea walls, lighthouses, and similar constructions, allows the mortar to be mixed of salt water.

It may be said that, as a general rule, a joint lighter than the brick is the most preferable, and a strong mortar of this kind may be made by starting with a pure lime and sand putty, and tempering it strongly as it is used with Portland cement. Care must be taken, however, in cleaning down a wall which has been laid with a wide joint of lime mortar, that the lime is not taken out of the joint to such an extent that the wall is whitewashed. If acid is used, it should be in very small quantities; but it is better to clean such brickwork with soda instead of acid, which, if the mortar is fairly well set, rarely starts the joints. It is also important that walls laid as described above should be laid so as to have ample time to become set before winter weather sets in. Care should also be taken to ascertain if there is any trouble liable to occur on account of unequal shrinkage in the mortar between the face of the wall and the backing. At one time it was often customary to lay the facing of brick walls, or at least a portion of it, in clear Portland cement, to allow the brick to be carved like stone after being set in place. There are instances where the unequal shrinkage or expansion of the different kinds of mortar made the facing scale off, and in time necessitated the removal of the entire outer 4 ins. of brickwork, but such trouble is undoubtedly less liable to occur with a wide joint in the facing, for in this case the joints of the facing and backing are more nearly equal.

Before the mortar between the bricks is set it is customary to "joint" it, that is to say, to compress it more or less by running an iron tool with a smooth surface along the joint, which compresses and at the same time indents the mortar. The jointer usually has a V-shaped edge which makes a sharp, narrow line, but sometimes a U one, which makes a slight indentation the full width of the joint. A good effect is obtained in some cases by simply cutting the mortar off with the trowel flush with the surface of the brick; but as this leaves a rough surface, the mortar is more liable to be affected by frost than where it is smoothed and compressed with a jointer. In jointing brickwork, where the bricks themselves are more or less irregular in shape and laid with a wide mortar joint, it is usually desirable to have the jointer run along the top of a straight-edge, which is carefully leveled each time. Although the method of jointing the mortar may seem at first thought an unimportant detail, yet experience will soon show that it is a matter which deserves careful attention, particularly on work which comes near the eye, as in the case of fence walls, gate posts, and other similar work. If, when the architect is to build a brick wall where he wishes to obtain the best possible results, he will have several samples laid up with the same brick but different joints, he will find that the difference in joints may determine whether or not the wall is satisfactory in both color or texture, and also that a poor brick may be helped, or a good one injured, by the color and width of the mortar. The brick joint is a factor much more important than is generally supposed, and is worthy much more consideration than is ordinarily given to it.

SAND.—Sand should be sharp, gritty, and clean, free from loam, clay, and other foreign substance. For mortar it should be screened to a proper degree of fineness. To test sand, take up a handful and squeeze. Its sharpness may be determined by feeling, and cleanness by the appearance of the hand, as clay or loam will soil the hand by clinging to it. A better test for cleanness is to drop a handful into a glass of clean water; dirt will not settle at the bottom, sand will.

COST OF CONCRETE.— With Portland cement at $2.20 per barrel, sand at $1.00, and broken stone at $2.00 per cubic yard, and labor at $2.40 per day of eight hours in New York City, builders get from 30 cents to 32 cents per cubic foot for concrete in place. In the repaving of Fifth Avenue, New York City, in 1887, with Rosendale cement at 90 cents per barrel, labor at $1.50 per ten hours day, sand at $1.00, and broken stone at $2.00 per cubic yard, the contract price was $4.00 per cubic yard in place, a perfectly fair estimate, the mixture being about 1 — 3 — 5, and laid 12 ins. deep over the entire 40 ft. wide roadway.

Recent Brick and Terra-Cotta Work in American Cities, and Manufacturers' Department.

NEW YORK. — Another month of unusual activity in the Building Department has just passed. The plans which have been filed include several very important large buildings, the designing of which, we are happy to say, have been placed in good hands and we need not be apprehensive of the result. We have it on good authority, however, that several of the buildings whose plans have been filed will not be erected immediately, this formality having been gone through so that their ultimate erection need not be prevented by a bill now under discussion in the State legislature, limiting the heights of buildings.

CAPS TO COLUMNS AT FIFTEENTH STORY, ST. JAMES BUILDING, NEW YORK CITY.
Bruce Price, Architect.
Made by Perth Amboy Terra-Cotta Company.

An item of particular interest is the decision of the owners to sell Madison Square Garden, the largest and most beautiful amusement place in America. All who are interested in the use of brick and terra-cotta know how successfully and how beautifully these materials have been blended in this splendid structure. The owners cannot be too highly commended for their generosity and public spirit in their endeavor to give the city of New York a building of which she is justly proud, nor the architects, McKim, Mead & White, for their eminently successful handling of the problem. The great building has proved an unprofitable adventure financially, and during only one or two years has it paid expenses. It is not likely that its sale will materially affect the appearance of the building, although the Madison Avenue section may be remodeled into an hotel.

A new building which, judging by the drawings, promises to be a handsome one, is the new Herald Square Hotel, by Hill & Turner, architects. This building will form a background to that admirable copy, the Herald Building, and will not artistically help the latter.

As a result of the generosity of Miss Rhinelander, a beautiful group of buildings will be erected on her grandfather's estate, for which purpose she has given over $500,000. The property is on the south side of East 82d Street, between First and Second Avenues, and the buildings to be erected will be dedicated to the purposes of St. James Parish.

Plans have been completed by R. H. Hunt for an addition to the Metropolitan Museum Building, which will cost $1,000,000. The bids for the foundation work have been received and the work is about to commence. This is an important step toward the completion of a grand museum, of which the present structure is only a nucleus. The proposed wing will be classic in the general style of its architecture and will be constructed of brick and granite. It is a very elaborate building and will probably take two or three years to complete.

Plans have been filed for a magnificent new home for the University Club. The building will be erected on the plot of ground at the northwest corner of Fifth Avenue and 54th Street, which was bought for $805,000. The architects are McKim, Mead & White. It is to be a handsome and substantial structure, and the interior arrangements, as indicated by the plans, are remarkably complete.

An office building will be erected at Nos. 225 and 227 Fifth Avenue for the Baroness de Salliere. It will be twenty stories high and will cost $500,000.

Harding & Gooch have prepared plans for a sixteen-story office building for John A. Roebling & Sons, to be erected at Nos. 117 to 121 Liberty Street. It will be of steel skeleton construction with a front of brick, stone, and terra-cotta. It is estimated to cost $500,000.

The same architects have also filed plans for a fourteen-story building to be erected for J. Hooker Hammersley at the southwest corner of John and William Streets. It will be only 27 by 78 ft. in size, but will cost $400,000. The front will be of granite and brick, with terra-cotta trimmings.

R. Maynicke has prepared plans for a twelve-story store and office building to be erected at No. 598 Broadway for Henry Corn. The cost will be $250,000. Also another similar building for the same owner at Fifth Avenue and 22d Street, to cost $200,000.

Neville & Bagge have planned seven flat buildings to be erected on St. Nicholas Avenue, at a cost of $190,000.

Clinton & Russell have prepared plans for a twelve-story brick building, Nos. 11 to 15 Murray Street, to be used for manufacturing purposes. It will cost $225,000.

Schickel & Ditmars have planned a five-story brick office building to be erected at Fifth Avenue and 91st Street, at a cost of $25,000.

C. C. Haight has prepared plans for an Hospital for the Ruptured and Crippled, to be built at 42d Street and Lexington Avenue. The cost will be $250,000.

Schneider & Herter have planned a six-story brick and terra-cotta tenement, 100 by 100 ft., to be erected at the northeast corner of Columbia and Delancey Streets, at a cost of $95,000.

Henry O. Havemeyer has sold to John S. Ames a plot, 150 by 200 ft., on Broadway, north of Prince Street, for $100,000. Mr. Ames intends to erect three twelve-story mercantile buildings.

TERRA-COTTA DETAIL, AMERICAN BAPTIST PUBLICATION SOCIETY BUILDING, PHILADELPHIA.
Frank Miles Day & Brother, Architects.
Made by Conkling-Armstrong Terra-Cotta Company.

PHILADELPHIA.— The removal of the capitol from Harrisburg to this city will apparently not take place, the project which was so vigorously advocated immediately after the burning of the capitol has been abandoned, and there will be a new building, for capitol purposes only, erected at Harrisburg upon the site of the burned structure.

STATE CAPITOL AT HARRISBURG, PA.

We visited the ruins shortly after the fire. If any bricklayer or mason desires to have an object lesson which will illustrate perfectly what has been said concerning good brickwork in the editorial department of THE BRICKBUILDER in the early editions of this year, he can get it there. We were so impressed with the stability of the walls after passing through so intense a fire that we had photographs made of the ruins, and present them herewith. Nowhere throughout the entire structure are they seriously injured. Over the openings, both large and small, the lintels burned away, and a few bricks fell with them; there are no cracks to be seen, and bulged walls or even isolated piers are out of the question; everything stands as perfect as it could be built new at the present time, especially the dome, which bore the brunt of the fire, and is standing today in a condition which would require only a few days' work to place it in the same condition that it was in before the fire. Notice, also, that on the front of the building the piers which supported a large pediment are still standing perfectly vertical, the woodwork having burned away, and the rafters fallen without injuring them in the least. The slender chimneys on either side of the dome, as well as the more sturdy ones on the outer walls, are all standing, the joists and rafters fell without any damage to the walls, leaving only the black openings which once held them; the interior piers which carried girders also remain standing in good condition. These walls were built in strictly plain and logical manner with good materials, they are laid in Flemish bond throughout, there being no exterior facing shell of wall bonded to the backing every seventh course, as we now have it in nearly all of our work. We cannot see why any architect who will view this mute but eloquent example of the durability of real good, honest brick-work should allow any of his work to be constructed in any other manner.

STATE CAPITOL AT HARRISBURG, PA. SHOWING EFFECTS OF FIRE.

The competition which has been announced by the Commission having in charge the selection of an architect for the new capitol, has been arranged for the Commission by their adviser, Prof. Warren Powers Laird, of the School of Architecture, University of Pennsylvania, and is designed to bring into the competition the best talent in the country, especial provisions having been made in this direction by the selection of six architects from those standing at the head of the profession, three of whom shall be from Pennsylvania and three from other States, who have been invited to submit designs, and who will be paid $1,000 each in compensation for taking part in the competition, but they shall not have any preference whatever in the selection of the design by reason of their being invited into the competition and paid by the Commission. The program insures the selection from the designs submitted, by a board of experts composed of three persons, the first of whom shall be the adviser of the Commission, Professor Laird; the second to be chosen by a majority of the six invited architects; and these two to select a third, of eight designs which in their judgment are best, giving to each their rank in accordance with their merit; these designs will be presented to the commissioners together with a full report of the proceedings of the board of experts, and such recommendations as they may deem necessary. The commissioners will select from the eight designs submitted by the board of experts, and will in nowise consider any of the others. The one which shall be selected as the most satisfactory shall be so designated, and the author of it shall be employed as the architect of the proposed buildings, with full authority as such, and shall be paid a commission of five per cent. of the cost of the work; two bronze medals shall be awarded to the authors of the designs adjudged as second and third respectively by the commissioners. No use of any other design or part of design shall be made unless by the consent and compensation of the author of it, and the drawings will be returned to the authors upon the conclusion of the competition, together with a full report of the board of experts and the Commission.

The program calls for a design for three department buildings in a group, the chief of which shall be the legislative building. The designs shall be sent to State Treasurer Haywood on or before 12 o'clock noon, Saturday, July 24, 1897, and the final selection of an architect shall be made not later than August 7. The drawings shall be enclosed in two separately sealed wrappers, the outer one of which shall be removed upon receipt of them; they shall have no marks whatever, as a number will be given each when the wrapper is removed, and this number shall be placed upon a sealed envelope containing the name of the author, which shall be enclosed with the drawings; these envelopes will be given to Judge Simonton, of the Dauphin County Court, to be opened by him after the selection of the design placed first.

The program has some unique features and is designed to overcome those which have ma le failures of most of the prominent com-

petitions of the past. It is very complete in every detail, and the result will be eagerly looked forward to by every person interested in competitions of this class.

CHICAGO.— We hear much of a great undertaking in the line of building a South Side lake shore drive connecting the Lake Front Park and Jackson Park. Mr. D. H. Burnham's name is prominently mentioned in connection with this enterprise, which is vast enough to require the issue of several millions in bonds before it can be realized.

The plan contemplates not only a driveway, but also roads for equestrians and bicycle riders, and these are to lie between the lake and a series of lagoons, while trees and shrubbery aid in making magnificent effects in the conception.

" Alterations " and " additions " form a large part of building items during times of business depression. Every few days one sees another store front undergoing transformation. A temporary sidewalk crowds passers-by out into the street, rows of blocking appear parallel with the front wall, a series of tall timbers with jackscrews in their lower ends form a dense colonnade outside, while another series extend in like manner inside the wall. Very soon needles of steel (I beams and rails) are made to pierce the walls and rest on the two rows of timber columns. Then the original supports are torn out, heavy brick piers and clumsy iron columns and mullions are removed, and for a time the building looms up in the air in a very awkward way on stilts, which seem to threaten to topple over at any moment. Slender columns and large sheets of plate glass are built in to give a maximum of light and show-window space, and then the owner is ready to offer inducements to prevent tenants moving into the new buildings. These changes in store fronts one and often two

ENTRANCE TO COMMONWEALTH AVENUE RESIDENCE, BOSTON.
McKim, Mead & White, Architects.

TERRA-COTTA CAP, WAREHOUSE, W. 14TH STREET, NEW YORK CITY.
Thomas R. Jackson, Architect.
Made by the New Jersey Terra-Cotta Company.

stories in height are a common sight in the business center of Chicago at present.

Mr. S. A. Treat, architect, has several buildings on the boards.

Howard Shaw and Hugh M. G. Garden each have some fine residence work for professors in the University of Chicago. The latter is designing, also, a hunting lodge or camp to be built in the wilds of Maine for a Chicago professor of philology.

Mr. Clinton J. Warren has in hand plans for transforming a four-story mercantile building into an eight-story hotel.

An organ factory costing $60,000 is being constructed under the direction of J. H. Wagner.

Some boulevard residents in Chicago have recently had the pleasure of paying $9,000 to prevent the building of an apartment building out to the lot line. This was reported to be a hold-up similar to one worked several times by a notorious builder of livery stables in residence districts.

ST. LOUIS. — The most important event in building circles this season has been the passage of the new building ordinance by the city council, and which went into effect on the 16th of April. The ordinance was prepared by a committee composed of members of the local chapter of the American Institute of Architects, the Master Builders' Association, and the Board of Public Improvements.

The committee made an exhaustive study of the building ordinances of the principal cities of this country and Europe, with a view of obtaining results in keeping with the requirements of modern times. The object has been to point out the things not to be done, rather than to prepare a specification for the architect.

The standard of buildings has been raised, and all buildings used for public purposes, such as theaters, etc., as well as buildings over 100 ft. high, are to be fire-proof, while the height of no building is permitted to be more than one and a half times the width of the street upon which it faces, and in no case to exceed 150 ft.

The passage of the ordinance occasioned quite a rush in the Building Commissioners' office the early part of the month to obtain permits before the law became effective, which resulted in permits being taken out for a twenty-story office building on 6th and Olive Streets, for which Messrs. Wheeler & McClure have prepared plans, and for a twenty-two-story building for the northeast corner of 7th and Olive Streets, opposite the Union Trust, plans for which were prepared by Architect Isaac Taylor. Also, for a theater on the corner of 6th and St. Charles Streets, for which J. B. McElfatric and Kirchner & Kirchner are the architects.

Sometime last summer, when the question of limiting the height of buildings was first agitated in the city council, a permit was

issued for a twenty-two-story office building on the southwest corner of 7th and Olive Streets, and all tenants were required to move preparatory to the wrecking of the old buildings, but the scheme seems to have been abandoned, and the premises have again become occupied.

TERRA-COTTA DETAIL, BUILDING FOR FERGUSON ESTATE, DETROIT.
Mortimer L. Smith & Son, Architects.
Made by Northwestern Terra-Cotta Company.

PITTSBURG. — Building projects are on the increase and new contemplations are reported nearly every day, among which is a ten-story building which F. Nicola, Esq., will erect, corner Penn Avenue and 4th Street, to cost $150,000. The Civic Club are considering plans for a new bath house to be erected on Penn Avenue, at a cost of $25,000. Architects Rutan & Russell are preparing plans for a central armory building, to cost $300,000. Architects Alden & Harlow are preparing plans for the South Side branch of the Carnegie Free Library, to cost $50,000. Architect Miss Elsie Mercur has been selected to prepare plans for the Washington, Pa., Female Seminary. Architect J. T. Steen is preparing plans for a brick church for the Cristion Congregation at Connellsville, Pa. Architects Riddle & Keirn are preparing plans for the Ninth U. P. Church, to be erected in Allegheny, to cost $20,000. Architect F. Sauer is preparing plans for a brick hotel to be erected at New Kensington, Pa. Architects E. J. Butz & Co. are preparing plans for the Lafayette Club house to be erected at Jeanette, to cost $10,000. Architect Chas. Bickel has prepared plans for an hotel and apartment house for J. Kaufman and others, to be fire-proof, of brick with terra-cotta trimmings, and to cost $200,000.

TERRA-COTTA CAP, OFFICE BUILDING, 78 FIFTH AVENUE, NEW YORK CITY.
Albert Wagner, Architect.
Made by White Brick and Terra-Cotta Company.

RESIDENCE AT BUFFALO, N. Y.
Broughton & Johnson, Architects.

PREVENTATIVE FOR DISCOLORATION ON FRONT BRICKS.

WE have recently had our attention called to the use of carbonate of barytes for the prevention of scum and discoloration on front bricks, terra-cotta, etc., and realizing the general interest the question bears to clay manufacturers, we quote the following extracts, translated from the German essay by W. Olschewsky, C. E. in *Ziegel und Cement.*

"Nearly all clay contains salts soluble in water; of these, the sulphuric acid salts, which are present in very fluctuating quantities in the clay used for bricks, terra-cotta, etc., are the most objectionable, as they cause scum and consequent discoloration. Most elaborate and costly alterations of kilns, etc., have often been made without effecting any cure of the evil. The cause is not in the burning or construction of the kilns, but to be found in the fact that scum and discoloration are already on the surface, before the bricks, etc., enter the kiln."

"Excellent and complete as the action of carbonate of barytes is as a cure for scum and discoloration from the chemical point of view, the practical man will nevertheless rarely obtain the desired result, if he adds the carbonate of barytes at random. To make this clear it is only necessary to say that sulphate of lime (gypsum) can be present in two different forms in the clay, viz., in a finely divided state (powder) and in the crystallized state, and that the method of treatment differs accordingly."

"The most complete assimilation of the carbonate of barytes with the clay is a condition, to obtain satisfactory results quickly and with the least possible quantity."

"It is difficult, however, to make sure of such assimilation by mere grinding of the ordinary carbonate of barytes; unnecessary loss is nearly always the consequence, as part of such barytes does not act. The coarser the barytes is the greater the loss."

"A most important advance towards a rational use of carbonate or barytes has been made by Messrs. Walther Feld & Co., who now produce precipitated carbonate of barytes of a fineness and power of action which could scarcely be attained by the highest possible state of fineness of the ordinary product, apart from the great expense."

We may add that other valuable literature and practical information on this matter may be obtained by communicating with Gabriel & Schall, 205 Pearl Street, New York. They are the sole importers for the United States and Canada for Messrs. Walther Feld & Co.'s pure precipitated carbonate of barytes.

OBITUARY.

JAMES WILLIAMS PENFIELD, President of the American Clay-Working Machinery Company, died suddenly, April 20, at Cambridge Springs, Pa., where he had gone in hopes of regaining his health which had been failing for some time.

Mr. Penfield was born in Euclid, O., and at the time of his death was sixty-eight years of age.

Much of the progress that has been made in the clay-working art of this country is due to Mr. Penfield's inventive genius. A life of ambition, vigor, and tireless energy earned not only for him a unique reputation, but brought to the industry with which he was identified that creative force which is to-day felt wherever burnt clay is employed.

THE LATE J. W. PENFIELD.

TRADE LITERATURE.

"25 to 40 per cent. saved in labor!" is the announcement made on the cover of the new catalogue issued by the Gilbreth Scaffold Company. The method by which this large percentage is saved is illustrated by eighteen cuts, showing the construction of the scaffold and its use in the various stages of masonry construction. F. B. Gilbreth, 85 Water Street, Boston.

NEWS OF THE MONTH.

MESSRS. WALDO BROTHERS, Boston, are the agents for the Atlas Portland Cement, also the Morse Wall Ties.

THE STANDARD FIRE-PROOFING COMPANY have removed their New York office to the Taylor Building, 39 and 41 Cortlandt Street.

I. W. PINKHAM COMPANY, Boston, are the New England agents for the Turnbull & Cullerton Patent Steel Lathing.

THE POWHATAN CLAY-MANUFACTURING COMPANY have removed their New York offices to the Townsend Building, 25th Street and Broadway.

THE WHITE BRICK AND TERRA-COTTA COMPANY, New York, have removed their offices to the Presbyterian Building, 156 Fifth Avenue.

I. W. PINKHAM COMPANY, Boston, have taken the New England agency for the Brooklyn Bridge Brand of Cement, also for the F. O. Norton Cement.

THE PENNSYLVANIA ENAMELED BRICK COMPANY, New York, have removed their offices to the Townsend Building, 25th Street and Broadway.

THE TIFFANY ENAMELED BRICK COMPANY, Chicago, will supply the enameled brick used in the Y. M. C. A. Building at Louisville, Ky., Val. P. Collins, architect.

J. W. HORNSEY has leased the plant of the Collinwood Brick and Terra-Cotta Company, Collinwood, Ohio, and will soon put upon the market a "High-Grade Impervious Brick."

THE STANDARD TERRA-COTTA COMPANY have secured through their New England agents, O. W. Peterson & Co., the contract for the terra-cotta on the church of the Blessed Sacrament at Providence, R. I. Heins & La Farge, architects, New York.

CONTRACTS have been closed for putting the Bolles Sliding and Revolving Sash in the following buildings: Six schoolhouses, New York City; Howard Auditorium, Baltimore; residence, John McHenry, Baltimore; residence, R. H. Yeatman, Baltimore.

THE TIFFANY ENAMELED BRICK COMPANY, Chicago, are now making enameled "soaps" having the same enameled face as the English size brick, but only one or two inches deep, as desired. Especially suitable where economy in space is necessary.

THE FAWCETT VENTILATED FIRE-PROOFING COMPANY, who have the fire-proofing contract for the new Registry of Deeds Building at East Cambridge, Mass., have placed their order for cement with Waldo Brothers, specifying Atlas Portland cement.

THE PHILADELPHIA AND BOSTON FACE BRICK COMPANY report the following new contracts: Gray brick for Slamm Building, at Washington, D. C.; cream brick for Steuben Street residence at Albany, N. Y.; gray brick for Angier Chemical Company Building at Brighton, Mass.

G. R. TWICHELL & CO., Boston, have closed the following contracts: Mottled brick residence for R. E. Lord, at Waltham, Mass.; gray brick for Baptist Church, Warren Street, Boston; front brick apartment houses, Waitt Street, Boston; and all the common brick to be used in the Russia Wharf buildings, Boston. C. Everett Clark & Co., builders.

THE TIFFANY ENAMELED BRICK COMPANY, Chicago, have appointed as their agents for the sale of enameled brick: W. S. Nelson, Kansas City, Mo.; Wm. J. Watkins & Co., Louisville, Ky.; Pittsburg Mortar and Supply Company, Pittsburg, Penn.; The Midland Brick and Supply Company, Cleveland, O.; B. S. Lewis, Nashville, Tenn.; Illinois Supply and Construction Company, St. Louis, Mo.

THE AMERICAN CLAY-WORKING MACHINERY COMPANY, of Bucyrus and Willoughby, Ohio, have opened a New York office in Room 103, 39 and 41 Cortlandt Street, New York, where they will be pleased to have all clay workers make their headquarters while in New York. The office will be in charge of R. C. Penfield, who will be pleased to attend to all wants of callers, whether they are probable

customers or not. The largely increasing Eastern trade of the company made it necessary to open a New York office.

D. P. Guise, one of the leading clay workers of Pennsylvania, has placed an order with the American Clay-Working Machinery Company for an Eagle Re-press. The Guise works will be further improved and will enter upon the new season fully equipped to get its share of the business.

Chambers Brothers Company have recently closed contract with the C. P. Merwin Brick Company, of Berlin, Conn., for one of their auger machines, with outfit of clay-preparing machinery in connection therewith, to make for them hollow building brick. At present there are large quantities of these bricks imported into their market from New Jersey, and after careful test they find that their own material is entirely satisfactory for the manufacture of these bricks, and have determined to equip for their manufacture.

Charles T. Harris, Lessee Celadon Terra-Cotta Company, will supply the roofing tiles on the following work: Residence for G. W. Fairchilds, Oneonta, N. Y.; A. W. Fuller, architect, Albany, N. Y. Residence for H. C. McCormick, Williamsport, Penn.; Bennett & Rothrock, architects. Residence for W. J. Frisbie, Camden, N. Y.; Gordon A. Wright, architect, Syracuse, N. Y. Art Gallery for J. W. Kaufman, St. Louis; Link & Rosenheim, architect.

The contract to furnish all the Portland cement required for the construction of the new South Terminal Station, Boston, which will be one of the very largest railroad stations in the world, has been awarded to James A. Davis & Co., 92 State Street, Boston, sole New England agents for the Alpha Portland Cement. This brand will be used exclusively in this important work. Shepley, Rutan & Coolidge are the architects, and Norcross Bros., builders.

The American Mason Safety Tread Company have just completed their contract for laying their Safety Tread on the new grand staircase of Messrs. Jordan, Marsh & Co., Boston.

These iron steps were originally made with a recess cast for rubber mats, nearly to the edge, leaving exposed, however, the iron nosings, which wore smooth, and proved a source of danger to both customers and employees.

The new Southern Railroad Station of the Boston Terminal Company, the Lowell Post-Office, the Boston Subway, and several new mercantile buildings are also being equipped with the Treads.

The American Enameled Brick Company, New York, have recently closed a contract with Norcross Bros., builders, and McKim, Mead & White, architects, for light buff front brick, including special fluted bricks for columns and pilasters in the interior of the Columbia College Gymnasium; also a large order for enameled brick to line the plunge bath there, in addition to the order recently filled for the same parties for another portion of the University Hall Building.

They have also secured contract for the enameled brick to be used in lining the Swimming Bath of the New York Athletic Club; these bricks to be made specially and glazed on the flat side.

The Columbus Brick and Terra-Cotta Company, Columbus, O., one of the very largest front brick manufacturers in the country, have recently supplied their brick for the following residences: Residence, Riverside Drive, New York, M. V. Ferdon, architect, light-gray Romans; residence for J. T. Blair, Columbus, O., terra-cotta and gray standards; residence for E. M. Huggins, Columbus, O., dark-gray standards; two residences for J. H. Outhwait, Columbus, O., gray Romans and standards; residence for W. H. Martin, Columbus, O., gray Romans; residence for Henry Flesh, Piqua, O., Peters, Burns & Pretzinger, architects, dark-gray Romans; residence for Mr. Kavelidge, Milwaukee, Wis., gray speckled and light-gray standards; residence for Mr. Manegold, Milwaukee, Wis., dark-gray standards; residence for Charles L. Kurtz, Columbus, O., Yost & Packard, architects, gray and buff Romans; residence for Dr. H. G. Campbell, Logan, O., terra-cotta standards.

THE HYDRAULIC-PRESS BRICK COMPANIES.

The Hydraulic-Press Brick Companies, although including thirteen separate and distinct organizations, located in nine States of the Union, may nevertheless be referred to as one company, whose history is replete with records of uninterrupted success from the time of its inception. The parent company was organized in St. Louis over thirty years ago, and since then the establishment of the several branch companies at different intervals and in various parts of the country attest the tremendous growth of the business and its far-reaching influence. The various plants are located at points stretching from as far west as Nebraska to as far east as New Jersey, and in a northerly and southerly direction from Minnesota to Virginia. Thus it will be perceived that working eastward the invasion of new territory by the Hydraulic-Press Brick Companies has been so constant and thorough as to render impossible one's successfully eluding their influence or finding a place where their bricks are an unknown quantity.

There has been a wonderful evolution and revolution in brick manufacturing even during the past decade. Formerly a brick-yard need only produce a good red or a good buff to secure enough orders to make their business profitable, because a very limited number of colors were used. So great a variety of new shades have been put on the market, and at once adopted by those seeking new effects, and more perfect harmony between brick and stone trim, and so widely divergent is the taste of architects and builders, that, to successfully compete on all kinds and grades of work, a brick-yard must now be able to make a large assortment of colors that possess enduring qualities beyond question. The Hydraulic Companies, keenly alive to this necessity, have kept it constantly in mind, and by developing the full possibilities of their old plants, and only starting new ones when the clay at hand would permit of producing a variety of shades, have succeeded in obtaining a most complete assortment of colors. When it is stated that the Eastern Hydraulic-Press Brick Company alone makes thirty distinct shades of front brick, and that all the other companies have also a large and distinct variety, the reader may form some idea of the extent of the assortment. Thus it is possible for them to satisfy the taste of the most fastidious, and furnish something that will harmonize with any combination of terra-cotta or stone trimming that the fancy may prefer.

These companies have been among the first to recognize the desirability of molded brick for the use of the architect, and under the direction of one of the foremost architects in Philadelphia, a gentleman of high reputation throughout the country, they have prepared a large number of shapes suitable for a variety of cases, and are prepared to supply these moldings in any quantity or color. These shapes and a number of suggestive sketches showing what can be done with moldings in bricks are admirably shown in a very artistic catalogue recently issued by the companies, forming a volume which has elicited unqualified approval from all the architects who have seen it.

To the architect and builder, the enormous facilities and unparalleled resources of the Hydraulic-Press Brick Companies are two of their most attractive features. Their production, amounting to considerably over 300,000,000 bricks annually, enables them to serve any number of buildings requiring large quantities of bricks without subjecting any to the delays, so annoying and expensive, which in many instances have brought a large office building beyond the renting season necessitating a valuable piece of property being carried from six months to a year with all outgo and no income. Particularly in cities like New York, having strict building laws which prohibit a building being carried up to but a very limited height without the front walls being laid, is the matter of prompt and efficient service, one of the most important considerations in awarding the contract for face brick.

Also, it is of the greatest importance that a concern handling front brick should be at all times conscious of the extent of their ability to execute orders entrusted to their care, so that in estimating

or submitting proposals for bricks to be furnished within a specified time they can be able to satisfactorily show their resources. The Hydraulic-Press Brick Companies are so organized that such a thing as a serious delay in supplying brick is almost an impossibility. The solicitors of the companies are constantly posted concerning the stock on hand and in process of manufacture, and know the exact quantity that may be offered for immediate delivery over and above orders previously taken. All salesmen are provided with this information in so condensed a form as to permit of their carrying with them the necessary papers for reference, and thus, wherever they may be, and without consultation with their respective offices, they can supply a customer with accurate and reliable information as to whether the bricks he wishes to purchase are available for immediate delivery, or, if needed, just the amount of time required to furnish them.

A first-class material, brought before the public by a perfect organization and a complete system, backed by the most thorough business principles, is the secret of the financial success which has attended the efforts of the Hydraulic-Press Brick Companies.

The Companies also make a great feature of their exhibits, which are arranged in panel form with a view to displaying the bricks so as to fairly represent their appearance when laid in a wall, as well as affording a visitor the opportunity of seeing the full line of colors located in a manner easy of comparison. This greatly facilitates reaching a final decision as to the shade desired, and is infinitely more satisfactory to the customer than being required to judge of the effect which a brick will produce *en masse* by seeing merely a single sample. A full line of molded shapes are also displayed, and good-size specimens of various-colored stones are kept on hand for the convenience of visitors who may desire to ascertain the effect of certain combinations of brick and stone. These panel exhibits are arranged in most all the offices, but particularly here in the East, where, without an exception, they are equipped to display the bricks in the manner explained above.

Aside from the home offices, which are located at points in close proximity to the respective factories, there are many branch offices, one of the most prominent of which is the one in the Metropolitan Building, corner of 23d Street and Madison Avenue, New York, under the direction of Messrs. Fredenburg & Lounsbury, who are, in fact, the sole selling agents in New York and New England of all the Hydraulic Companies. Notwithstanding the fact that the New York and New England markets were the last in which the hydraulic bricks have been offered for sale, the volume of business done in New York and Brooklyn alone in '95 and '96 included the furnishing of high-grade front bricks for 1,288 buildings, an average of more than two for each working day. This is entirely exclusive of the New England business, which has grown to such proportions that a spacious new exhibit room has recently been opened in the Equitable Building, Boston. The exceedingly handsome panel exhibit displayed in this office is a revelation in its assortment of shades and qualities to those who are not familiar with the operations of the company.

In dealing with any of the Hydraulic-Press Brick Companies at their home offices, or with Fredenburg & Lounsbury, the customer comes in direct contact with the manufacturer, and will, therefore, receive that attention which is to be had only when dealing with principals.

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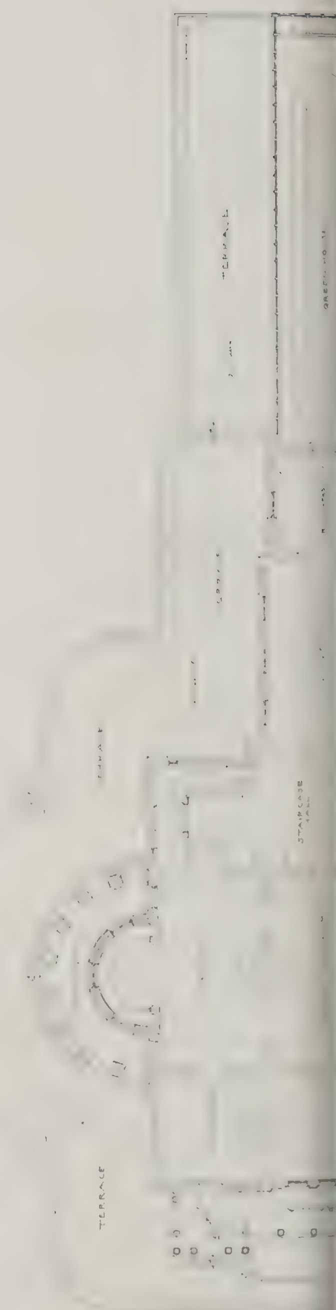
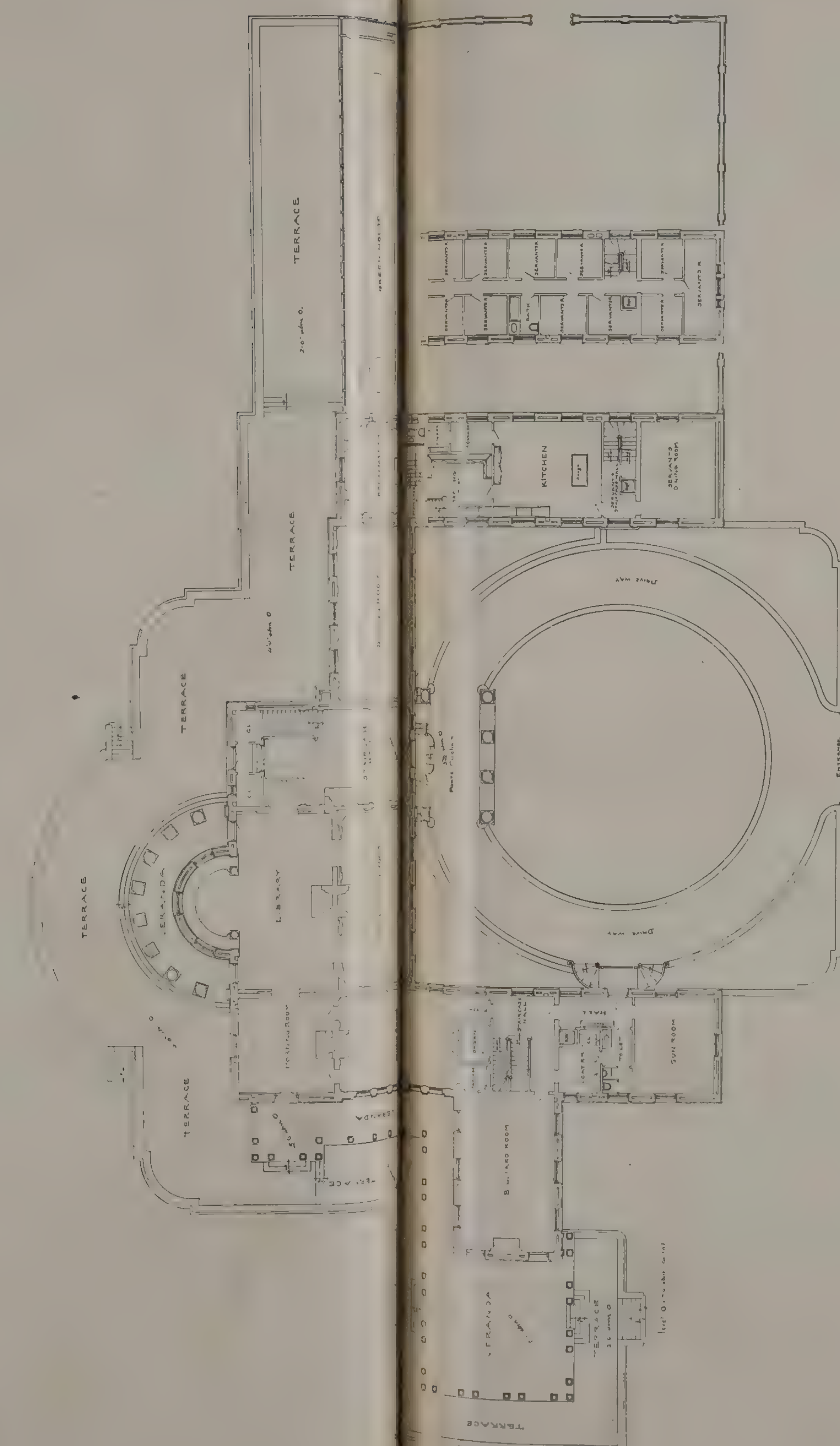
Rear Elevation.



REAR ELEVATION.



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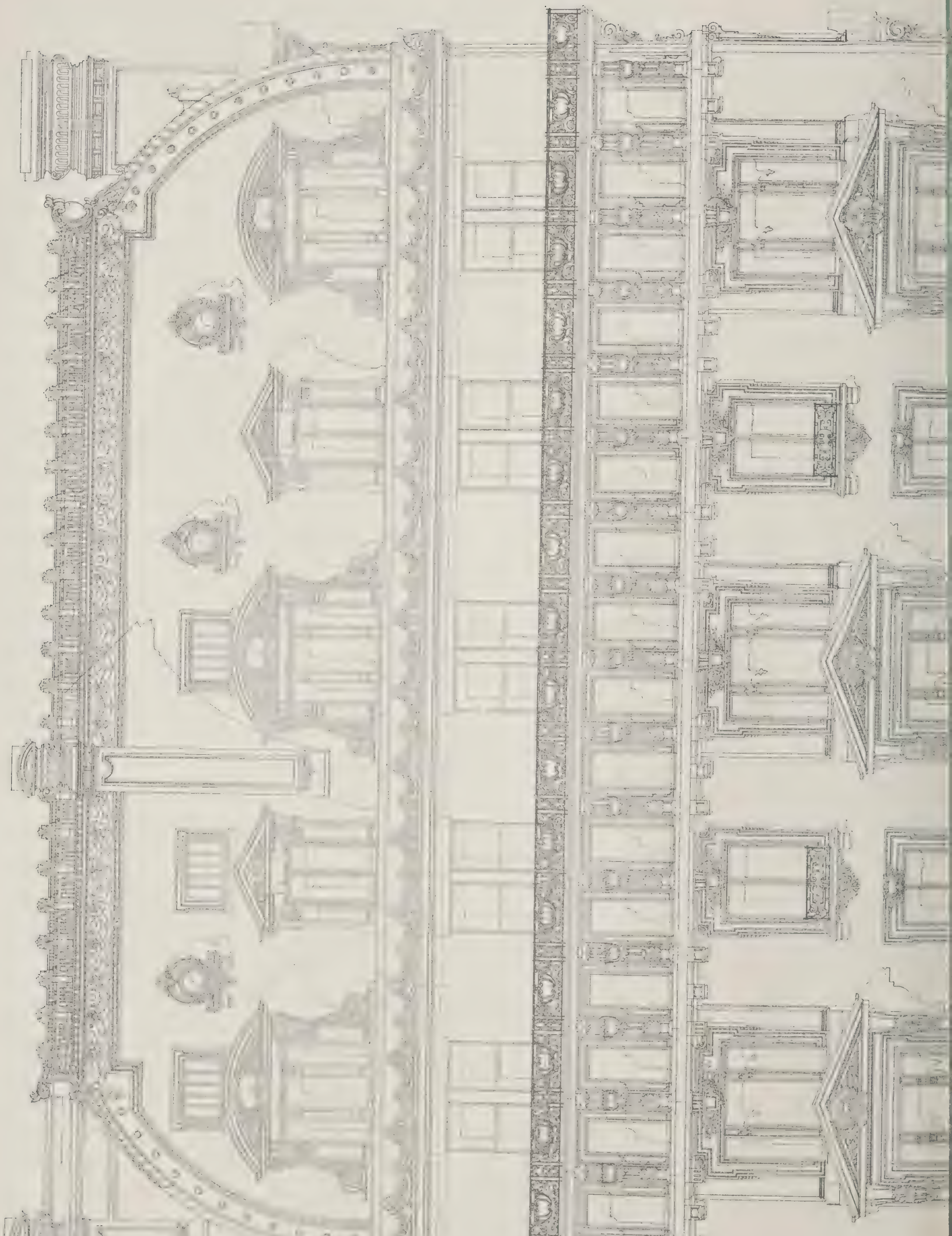
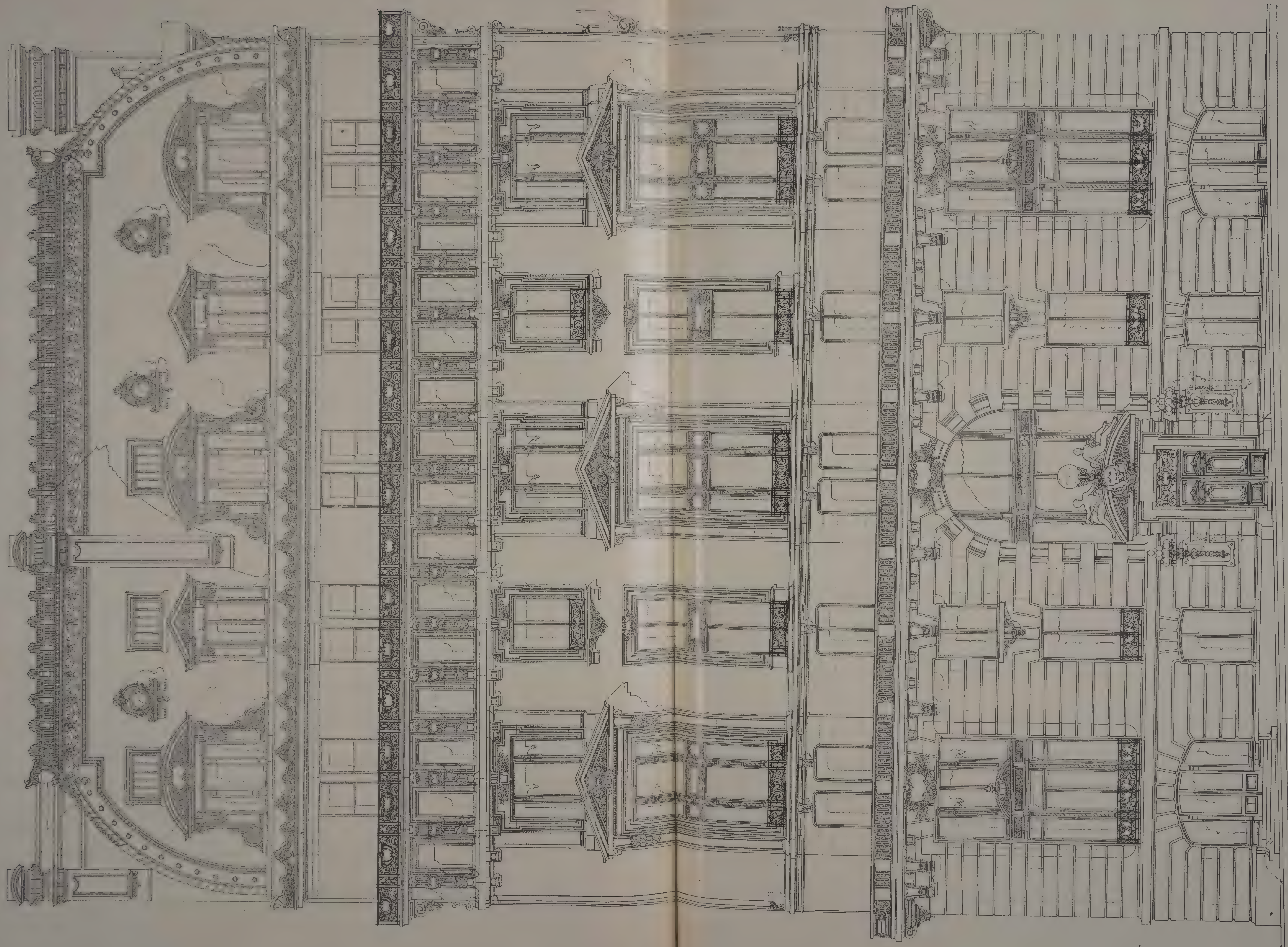
ERNEST FLAGG, Architect.





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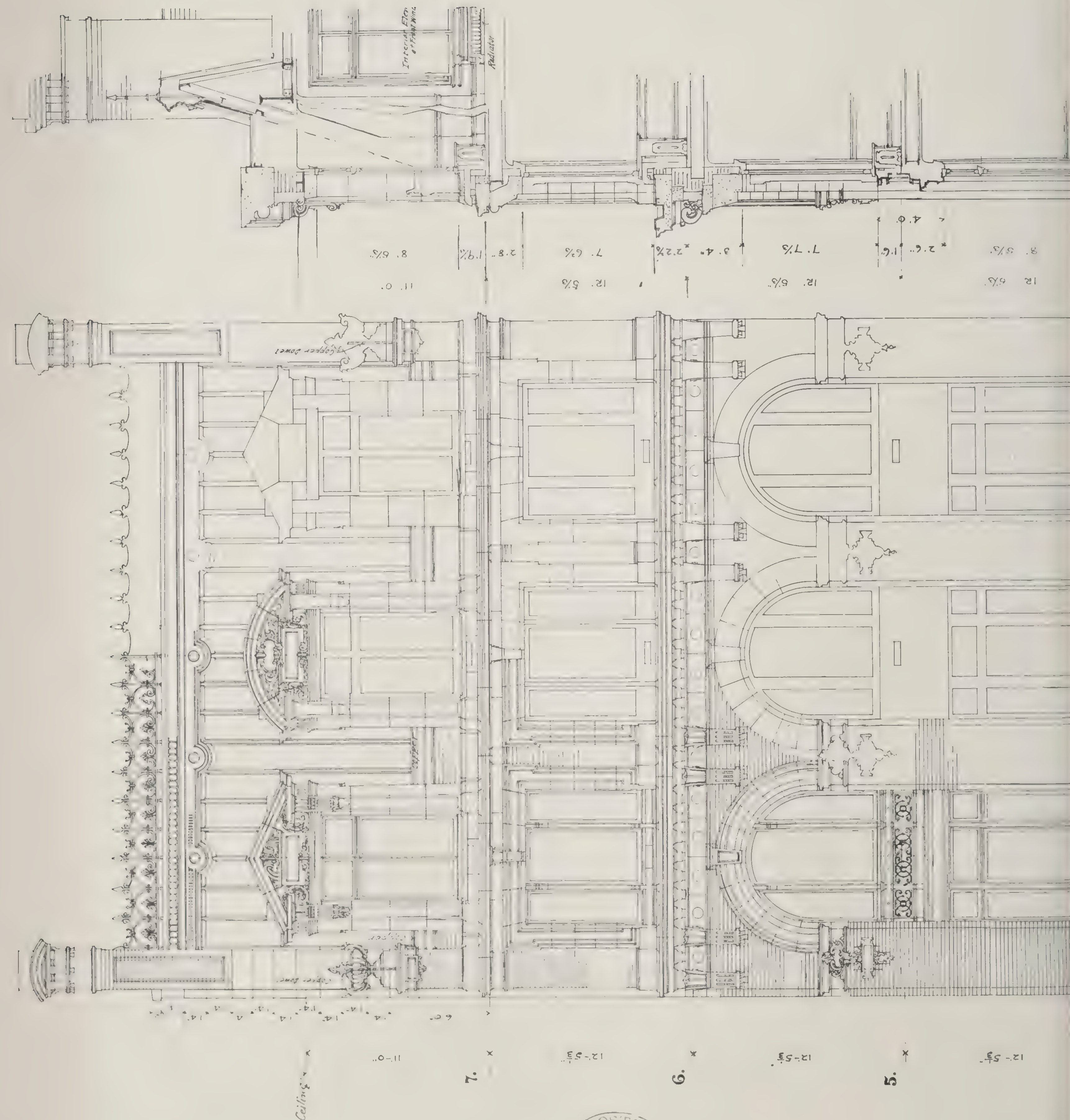
ERNEST FLAGG, ARCHITECT.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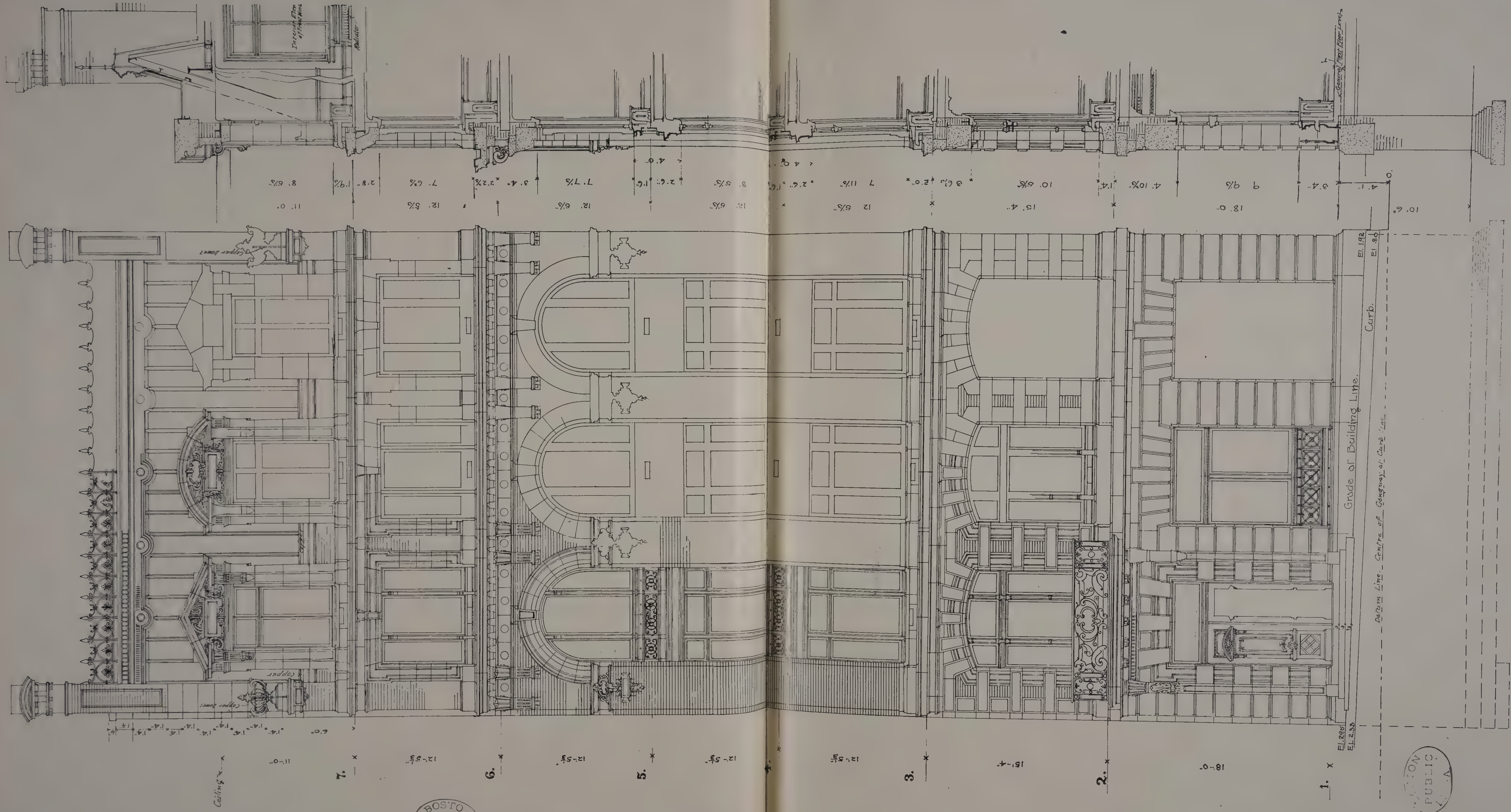

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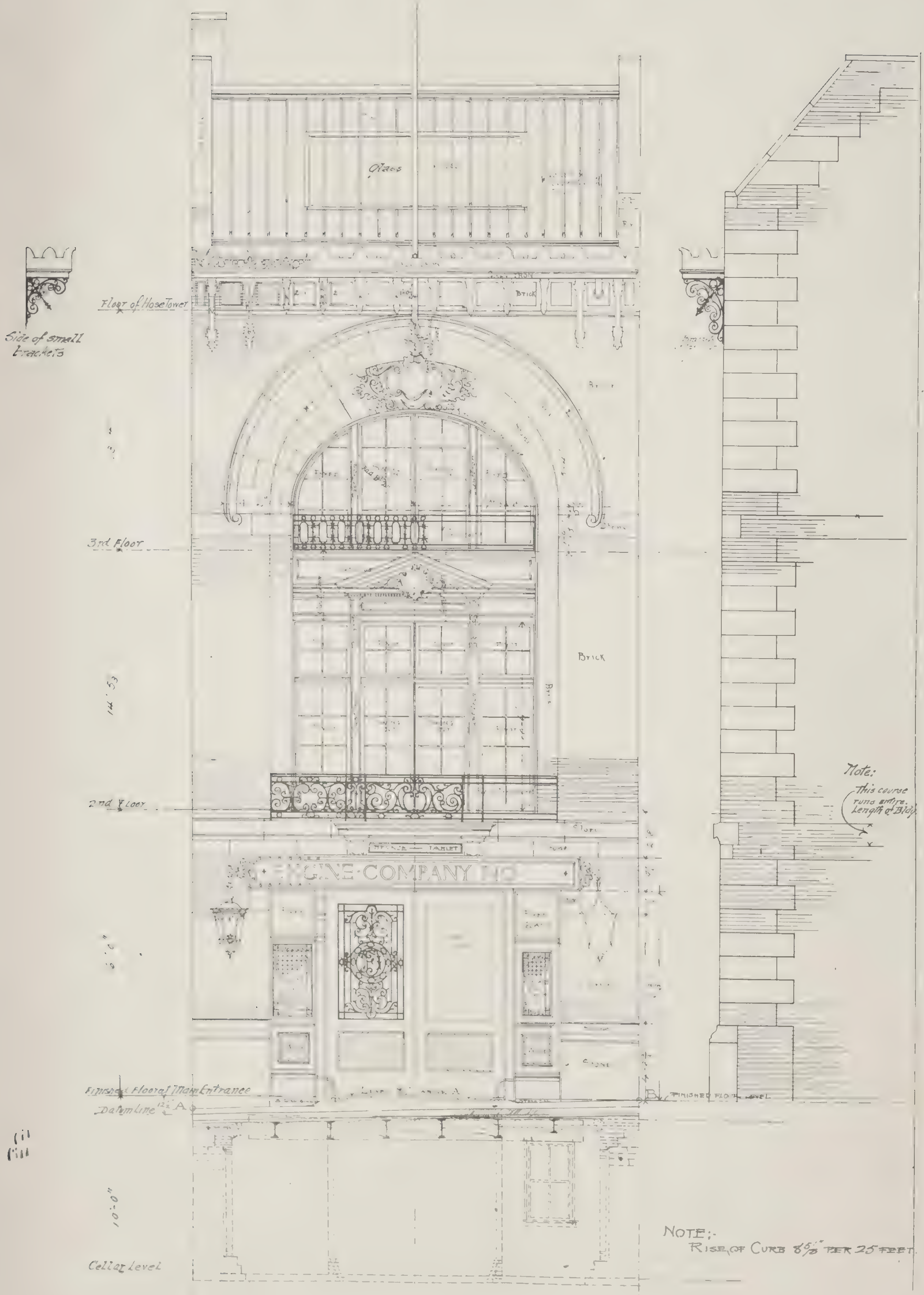
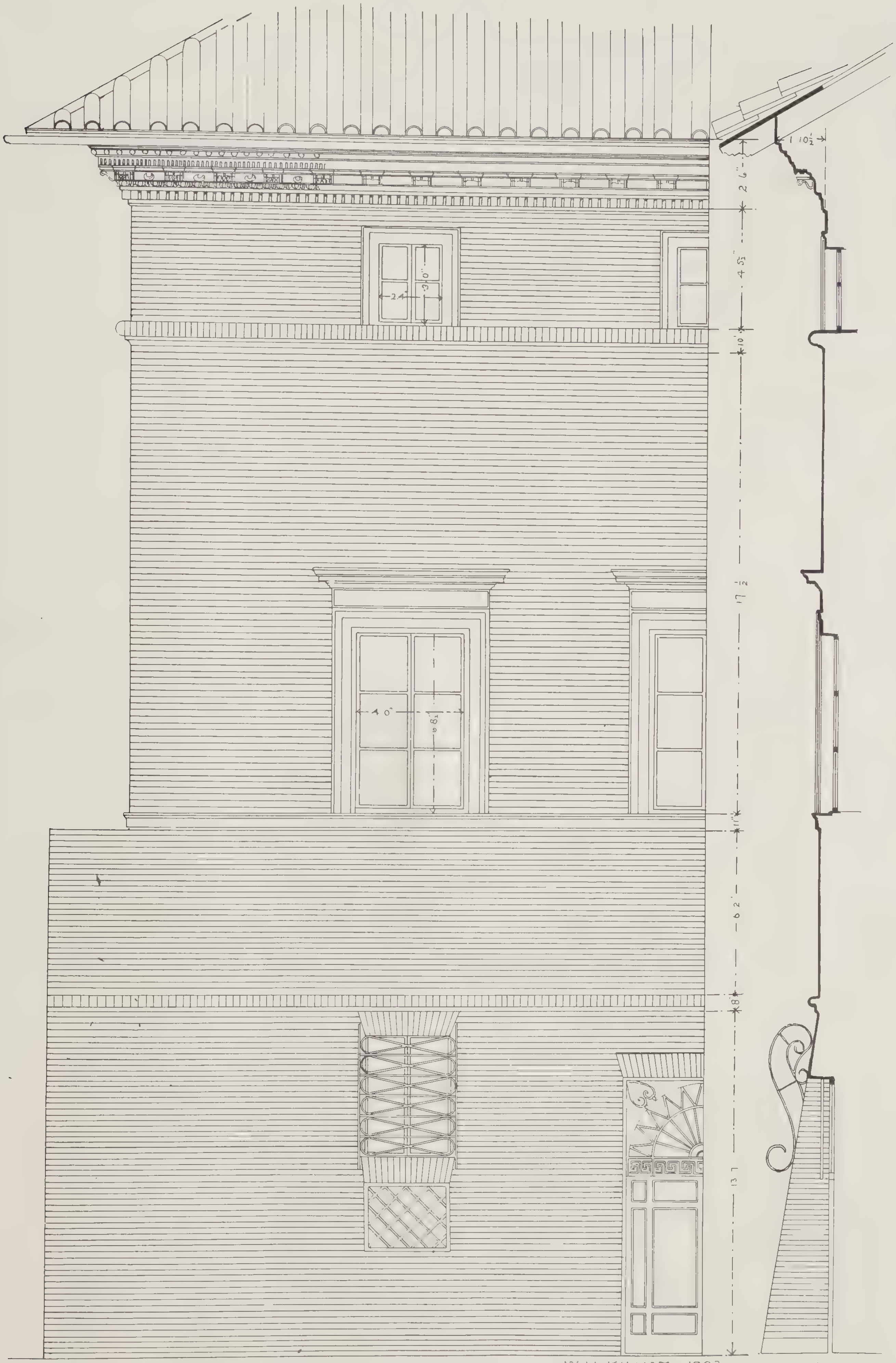


ENGINE HOUSE, NEW YORK CITY.

ERNEST FLAGG, Architect.



DETAIL, PALAZZO POLLINI, SIENNA.

Measured and Drawn by WALTER H. KILHAM (Rotch Scholar).

VOLVME VI JUNE 1897 No. 6

THE BRICKBVILDER

OFFICE 85 WATER STREET BOSTON

THE BRICKBUILDER.

AN ILLUSTRATED MONTHLY DEVOTED TO THE ADVANCEMENT OF ARCHITECTURE IN MATERIALS OF CLAY.

PUBLISHED BY

ROGERS & MANSON,

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THE building law of the city of Boston has for years prescribed that no portion of a building shall project beyond the property line without special permission obtained through certain designated channels. By common practise it has come to be understood that this restriction applies only to portions of the actual building, and not to string-courses, pilasters, belts, etc., and up to a very short time ago projections even of considerable size, which started from a height of not less than 7 or 8 ft. from the ground, even though they bodily overhung the street line, were not considered infractions of the law. This was common practise rather than by statute law, however, and as the building ordinances distinctly stated that no projections whatever should be made beyond the street line, it was quite natural that such regulations should give an opportunity for differences of opinion as to the right of even a cornice to overhang the street. A case occurred only a short time ago in which the owners of a certain large building were absolutely prohibited from projecting the cornice, though this prohibition was subsequently removed and the cornice was built as originally planned. When the Brazer Building was started in this city, and before the cornice was reached, a protest was made by an adjoining property owner against any projection of the cornice, which, while by no means as pronounced as many other cornices of existing buildings, was planned very naturally to project beyond the line, and this projection, if considered in the light of the letter of the law, was not permissible. The objections which were raised led to considerable strong feeling, and by a proposed compromise the total projection of the cornice, which was of terra-cotta, was to be reduced from 2 ft. to 9 ins. As one of our daily papers well stated, logically followed out, the law, according to the city solicitor's construction, would stop all cornices,— the most important and often the only redeeming architectural feature in the modern city sky scraper,— all belt courses, all ornamental features, one may almost say, in the down town commercial building, reducing it to the mere dry-goods box it is so often caricatured as being.

Such a rigid interpretation of the law is so manifestly unjust that its enforcement was bound to bring about its repeal; and a new law has just gone into effect which is in some respects better than the old uncertainty in that, distinctly recognizing the fact that the cornice of a building must project, it sets a limit of 3 ft. to such projection. In regard to the construction of cornices, the law states that if of stone, each stone shall balance on the wall, which certainly is a wise and a necessary restriction, but it is discreetly silent in regard to the construction of terra-cotta cornices, the details being subject to the approval of the building commissioner, who, without laying down urgent laws, has always advocated that terra-cotta should, where practicable, be constructed in the same manner as stone, that is to say, should be balanced fully on the wall. The introduction of the steel skeleton, which is an admitted fact in the construction of nearly all large buildings, has made it possible, however, to enormously reduce the quantity of useless terra-cotta, which would be required if every block were to run clear through the wall and balance on the other side, and by a judicious employment of steel framework it is now possible to cut down the depth of terra-cotta, to a minimum, at the same time obtaining a greater security and a more rigid construction than would have been possible without the use of steel. Our constructors have been slow to accept the possibilities of the framed cornice. Although this is a logical and perfectly natural outgrowth from the skeleton construction, the custom of years, the habits of construction which have survived so many changes in style, have operated to produce a timidity in the projections, an unnecessary clumsiness in construction, which can be entirely avoided if we once recognize frankly the possibilities of a framed construction, and proceed scientifically to hang all the terra-cotta work onto the frame. The laws and the practise in regard to this construction are not yet fully determined, but the Brazer Building, previously referred to, will have a strong influence in determining the point of view in the future. The cornice on this building as originally planned was admirably framed; there was no useless terra-cotta, and while full projection was obtained, and not the slightest sacrifice made to artistic effects, it was structurally and scientifically correct. The cornice which is now on the building in place of the one originally designed is equally well constructed, though with not so much projection, and with corresponding loss, we fear, to the general effect of the building. The illustrations which we have published of late of the various constructions for projecting terra-cotta work have served to show how some of our best constructors handled a problem of this sort, and if there were more such examples in actual practise, if we would persistently regard terra-cotta as an envelope to be clothed upon a steel frame, to treat the terra-cotta in its purely decorative spirit, ornamenting the construction rather than undertaking to construct the ornament, our public architecture would be the vast gainer thereby. Stone is too heavy to be used to advantage for projections of a steel frame building. It cannot be molded around the supporting members, it must thoroughly balance on the supports as well as be tied back to them, and it is much more expensive to set in place even if the structural difficulties could be overcome. It goes without saying

that all terra-cotta cornices are not well constructed. Indeed, notwithstanding the balancing traditions, there have been several instances where terra-cotta projections have been carried to an extreme which has resulted in failure, but such failure has resulted almost entirely from attempts to diminish the thickness of terra-cotta without the use of steel framework, which is an impracticability.

There is a point to be considered in connection with projecting terra-cotta members of a street front which might easily be neglected. The terra-cotta work must not only be properly hung to the steel frame, but must also be so constructed that it will be secure against a pretty considerable blow from the outside. In case of a fire the firemen would naturally attach their ladders to the cornice. The force of a stream of water delivered from one of our heaviest modern fire engines, if at close range, would be something like 250 or 300 lbs. per inch. If the terra-cotta is made of slight thickness or is not securely held in place, it is liable to be cracked by the weight of the ladders, or even shattered by the impact of the water from the hose. In either case the result would mean a destruction of the cornice and danger to the firemen below.

Our building ordinances practically do not recognize the existence of a steel frame, at least not in this city, and all of the large buildings which have been erected within recent years have been built under a species of official tolerance rather than by direct accord with the wording of the law. Our statutes still continue to prescribe the thickness of wall for a building carried to a height of 125 ft., when as a matter of fact there has been hardly a building erected within the last five years with a wall of a height of even 50 ft.; and considering the success which has attended the introduction of the modern construction, the facilities for the use of brick and terra-cotta in an intelligent and workmanlike manner, it is high time that our laws should recognize the new construction, and the statutes be changed accordingly.

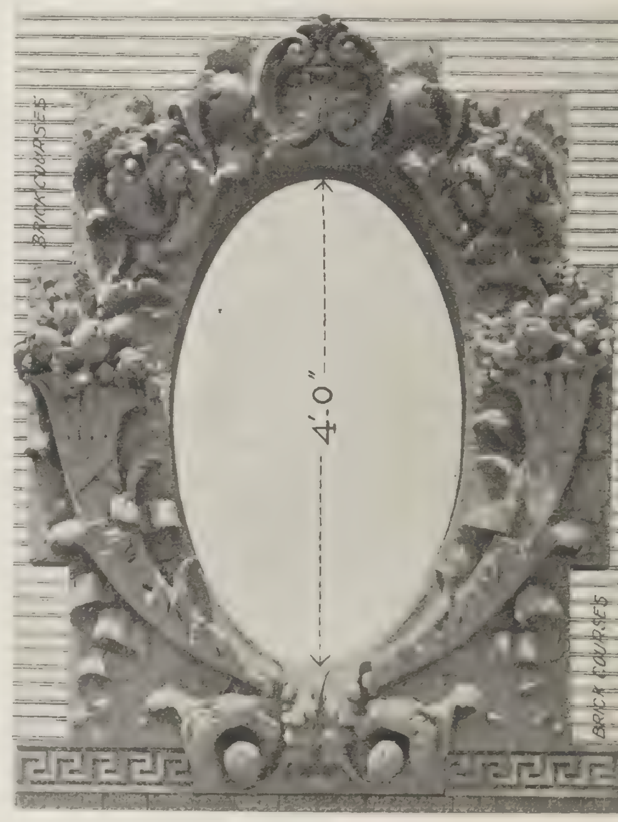
WE present with this issue the façade of three dwellings designed by Marcus T. Reynolds, of Albany, for the Van Rensselaer family, and erected on the principal residential street of that city, not far from the park entrance. While the building contains three separate residences, the connection between the several owners permitted, and the importance of the situation demanded, a more imposing palatial effect than would have been possible had each dwelling been treated as an entirety. The architect's aim in this respect must have been steady and deliberate, for he has attained the desired end with more than ordinary success.

The first story is executed wholly in terra-cotta blocks of two designs; one course being rusticated, with a vermiculated surface; the alternating courses having a reticulated pattern in low relief. With the exception of the mullions and spandrel panels in the second story windows — which are dark-red Verona marble — the architectural features of the two upper stories are likewise in terra-cotta, with Roman brick of exactly the same shade of golden buff for all plain surfaces. The second story windows resemble the characteristic double-headed windows of the early Florentine palaces. In those of the third story a square opening is surrounded by a rich architrave on which rests an entablature with a garland of fruit as the frieze. The pediment recedes towards the wall, in keeping with the ornate but unobtrusive character of the adjoining ornament, and suggesting a pediment more by its triangular shape than by its treatment. The sky line has not, in this case, been disfigured by any crowning abomination in galvanized iron, painted, and sanded with transparent artifice and fraudulent intent. The main cornice is terra-cotta. Clusters of acanthus alternate with baskets of flames along the frieze. Indeed, from the repeated use of flames as a motif on this particular building, we infer that they must have some especial significance — perhaps the crest of the Van Rensselaer family.

Mr. Reynolds seems to have studied to some advantage the many beautiful examples of terra-cotta architecture that abound in the palaces and churches in the valley of the Po. With the work of many generation of artists, in an artistic age, to draw from, he has wisely refrained from the invention of a new style. He has, however, sought to begin where they left off, and to carry terra-cotta architecture a step further by careful study, and a close observance of its capabilities. A laudable effort has likewise been made to show that the attributes of this material are different from those of stone, and that they demand a distinct treatment. The candor and consistency displayed in this is quite refreshing — a veritable oasis in a desert of sham and imitation. Whether it be in the choice of color, the peculiarity of finish, or the style of detail employed, the architect has made it plain that burned clay is the material; that it stands on its merits, that it needs no apology, and that it refuses to be considered an imitation of stone. It is on the fulfilment of these conditions that the future of terra-cotta depends, and on this basis that its ultimate destiny must rest.

ILLUSTRATED ADVERTISEMENT.

THE New York Architectural Terra-Cotta Company send us the adjoining illustration of an elliptical window. The photograph was not taken from the model, but from the actual work as it came from the kiln, and is therefore a real, as distinguished from an ideal representation.



PUBLISHERS' ANNOUNCEMENT.

OWING to the length of Mr. Wight's detailed account of the Pittsburgh Fire, which, because of its importance in demonstrating the value of the present methods of fire-proof construction, we feel justified in printing in full in this number, we have been obliged to hold over until July, Mr. Cusack's next instalment on Architectural Terra-Cotta.

MR. CUMMINGS's series on American Cements terminates with this issue of THE BRICKBUILDER. At an early date this work will be published in book form, which will comprise two very interesting chapters in addition to those which have already been printed in these columns. Due notice will be given of the date of publication.

Terra-Cotta Cornices for Steel Skeleton Buildings.

BY W. L. B. JENNEY.

As terra-cotta is the material best adapted to the street fronts of the steel skeleton, lapping around the horizontal flanges, easily secured and fire-proofing the steel, the terra-cotta cornice is in general use in high buildings. The essentials are: —

That the terra-cotta shall be very securely and substantially supported and anchored. To this end the steel and the terra-cotta must be designed together. All supports and all anchors must be shown on the designs, that the holes in the terra-cotta and in the steel may be made in advance, and the anchors provided. Usually there is a portable forge at the building for heating rivets, where the lengths and shapes of the anchors may be adjusted to fit correctly as the terra-cotta is set.

Strong Portland cement mortar only should be used; the outer one or two inches the color of the terra-cotta. Unless Portland cement is used, the mortar joints will be affected by the frost and ere long fall out, and water will enter, freeze and displace, or break, the terra-cotta.

All terra-cotta should be reasonably straight and hard burned.

The examples shown are from the finest types of office buildings. They are reduced from full-sized working drawings and are exactly as constructed in the several buildings respectively.

It will be seen by inspection that the supports and anchors vary greatly with the design of the cornice, and when it is a question of economy, this should be kept in view in designing the cornice. Other things being equal, the cost increases with the projection. It is desirable, whenever practicable, to consult with the terra-cotta company before the details are finally settled, as they must furnish and set the material, and sometimes very valuable suggestions can be obtained from them contributing to the stability and economy.

An old French professor in the Ecole Centrale at Paris was fond of telling his students, "Never lose the opportunity to consult with those who know more than you on any subject, and remember that an intelligent foreman often possesses practical knowledge on some minor points not found in the books that may be of great benefit to the professional architect and engineer."

This is quite likely to be true in terra-cotta cornices. The terra-cotta must be molded, baked, and set, and if the facility for doing these three things is kept constantly in view in designing the cornice, the most substantial and the most economical cornice will be obtained. It is often easy to add to the stability, and to diminish the cost by chances that do not injure the architectural effect.

Discussion of the examples presented: —[1]

Trude Building: —

This is for an ornamental cornice — a reasonably simple one. The minimum projection beyond the building line is 3 ft. This projection is supported by a system consisting of steel ells nearly vertical, extending from the level of the attic floor upward about 4½ ft., and outward to the building line or face of the vertical wall, and secured at the ends by gusset plates to the I beams, at about the attic floor level, and to the horizontal 4 by 4 ells, forming cantilever that with the longitudinal ells forms the main support of the extreme projections. The system is tied back to vertical ells against the inner face of the outer wall of the building. The two lower terra-cotta members shown in the designs are the window caps. They should be filled with concrete. Particular care is required. The work is set from outside scaffold. The filling is partly in advance and partly after anchors are in place, as may be in each case found most convenient. It is easily seen that the anchors must fit with exactitude.

[1] See plate page 116.

In this example, below the cap members there is no filling of the terra-cotta outside of the face of the outer wall of the building. The inner and upper cap member rests on a longitudinal brick ledge and should be filled as far as practicable in setting. For filling there is nothing better nor more convenient than good Portland cement mortar and broken terra-cotta.

The extreme outer members are not filled. The coping of the parapet wall should be filled. In this case, it would be advisable to build short 9 in. walls in the center of the parapet wall, and of proper height and length to allow the pieces of coping to be set in place. The proper amount of cement mortar is filled into the coping before setting, that the coping may be substantially full. Every care and precaution that ingenuity can suggest must be exercised to prevent the entrance of water within or between the pieces of terra-cotta. To this end it is best to fill every piece whenever practicable. Every joint must be filled over the entire surface with best Portland cement, and clean, sharp sand, equal parts and thoroughly mixed. A thorough mixing is more important than is generally supposed. At length this matter is attracting the attention of engineers and contractors, and machine mixers are now being used. Recent tests made by Ransome with one volume of Portland cement and three of sand showed a very decided improvement in machine mixed over the usual hand mixed.

All joints that come to the surface must be scraped out and thoroughly pointed with Portland cement used neat, or with not to exceed equal parts of the best, fine, sharp sand; coloring added where necessary. In special cases, caulking with oakum or flashing with metal is to be recommended; in fact, no precaution available should be neglected, as the introduction of water within a terra-cotta cornice in freezing weather may produce most serious accidents, displace and break pieces which by falling might result in loss of life.

Fort Dearborn Building: —

In this example very little steel is required, and is a good example of how to build a showy, deep cornice at minimum expense. The risk of leakage into the cornice is also reduced to the minimum, the only exposed joints being the cross-rolled joints between the pieces in the cap course.

If every piece in this cornice were filled as it should be, this example is very substantial, leaving little to desire in that respect.

The Fair Building: —

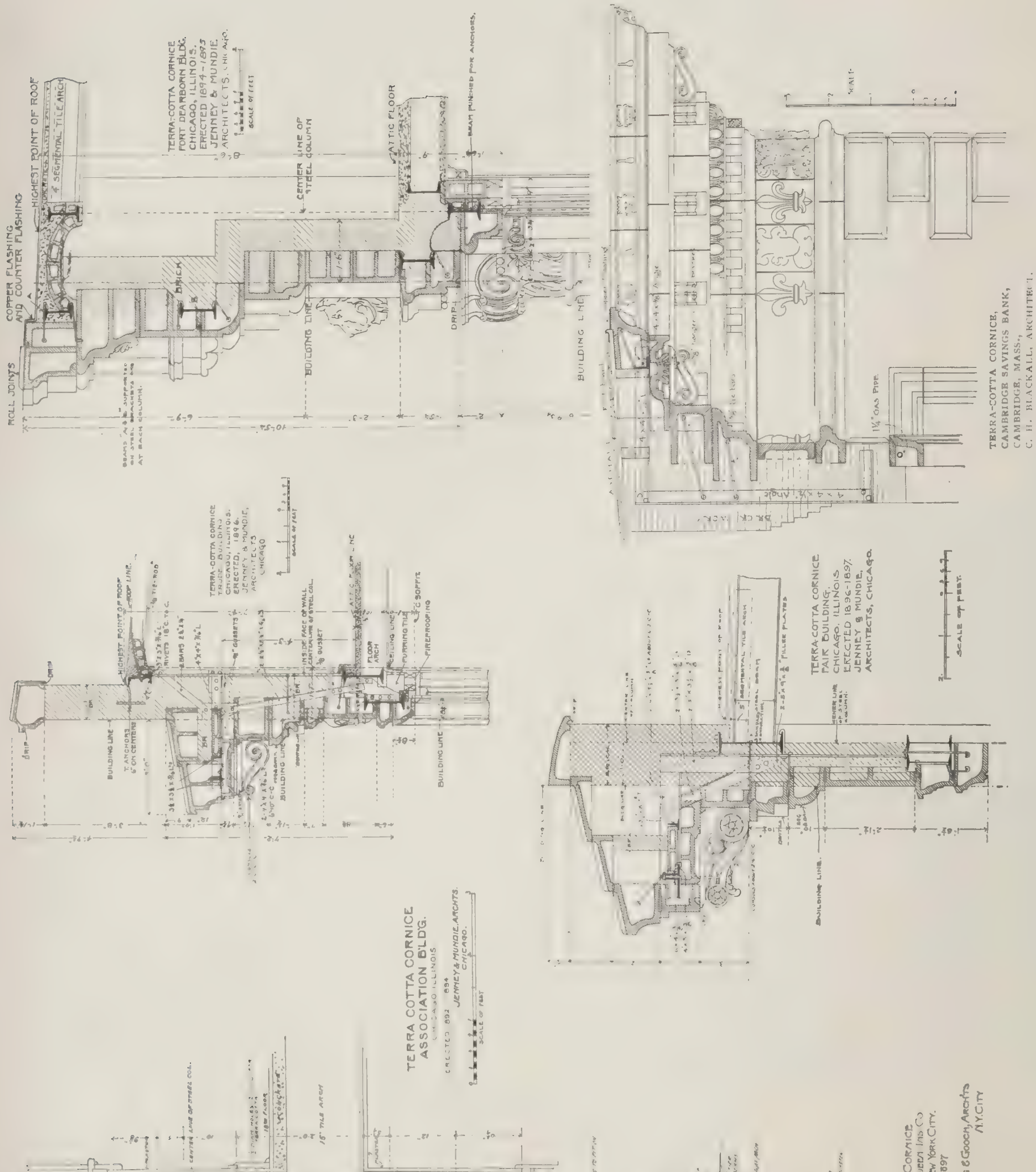
In this example, the system of steel supports is similar to that used in the cornice of the Trude Building, and there is but little to add. It is certainly desirable to build the supports strong enough to allow the cap to be filled, certainly the inner section.

The Association Building: —

This example is located below the attic story and tile roof. The sills to the windows above cornice might have projected with a drip beyond the face of the wall. The masonry, however, is so solid below that it is not essential. The longitudinal joints between the two cap pieces require special attention.

The filling of this cornice should extend out beyond the wall line, completely filling the lower courses and filling out to the outer edge of the outer I beam, carrying the cantilever in the upper courses. The ornamental soffit, as in some of the other examples, is suspended to the cantilever beam by concealed iron hangers. This method is often employed and offers little difficulty. It is easily managed by mechanics, who are otherwise capable.

Terra-cotta cornices in general require expert knowledge and the best of workmanship. None but the most experienced and reliable workmen should be employed in the setting. The terra-cotta should be rigorously inspected, and every defective piece discarded. The setting should receive the closest superintendence.



TERRA-COTTA CORNICES FOR STEEL SKELETON BUILDINGS.

THE RECENT FIRE AT PITTSBURGH.

A REAL TEST ON A GREAT SCALE OF FIRE-RESISTING CONSTRUCTION AND MATERIAL.

BY PETER B. WIGHT.

ON the evening of the 2d and the morning of the 3d of May there occurred in the city of Pittsburgh a serious fire, which is no longer a matter of news, but rather one of great public interest. There was a great property loss in the aggregate, which fell mostly upon the underwriters, said to be from $2,000,000 to $3,000,000. But that will depend upon what they agree with the owners to be the damage to several intentionally fire-proof buildings. The main interest taken in this fire centers upon the part sustained by three new buildings in which modern fire-proofing methods were employed, as well as a fourth, which escaped without more injury than broken glass, and a fifth with a broken roof. Of these four were fire-protected mainly according to one system, while the fifth differed from all the rest; yet all were different in some respects as to construction, and the circumstances of exposure differed in every case. They will serve as the basis for comparison of methods and materials in the experience of actual and, in some parts, crucial tests, to which the most improved methods of building have never before been so exposed as to amount to a demonstration. It is doubtful if either of these buildings would have been so seriously damaged had the fire originated within it, and the fire department been promptly called, in which case the event would not have attracted more than passing comment. It has always been supposed that the greatest danger to buildings is from fire within, and that fire-proof buildings are competent to protect themselves, on account of the incombustible nature of their materials, from fires in adjoining buildings, or across the streets, without resorting to the methods employed to keep fire out of others which make no pretensions to being fire-proof. The experience of the Pittsburgh fire has shown that a failure to provide against this unforeseen danger exposes fire-proof buildings in certain localities to tests of a severity never before anticipated.

Hence the proprietors of THE BRICKBUILDER have considered the occasion to be a proper subject for critical examination. At their request the writer visited the scene of the fire on May 25 and 26, a little more than three weeks after its occurrence, and before the buildings had been repaired to such an extent as to obliterate any of its effects.

The fire started in the wholesale grocery house of T. C. Jenkins, which runs through from Liberty Avenue to Penn Avenue, a distance of 236 ft., had a frontage of 87½ ft. on Liberty Avenue, between other stores, and of 150 ft. on Penn Avenue, between a brick dwelling and Cecil Alley, where it had a frontage of 107 ft. This store, it will be seen, was L shaped, six stories and basement in height, and covered 28,675 ft. of ground. It was in open lofts on every story with the exception of a section of 62 by 35 ft., which was partitioned off by a brick wall. It had about ten elevators. No attempt had been made to fire-proof it, and the construction throughout was with oak posts and girders and ordinary floor joists without any plastering. It was stocked with goods of the most combustible character, usual with wholesale groceries, from basement to attic, including a large stock of oil and sugar, as well as wooden ware. A switch track from the Pennsylvania Railroad in Liberty Avenue entered the building. There were standard shutters on the Cecil Alley front as well as on the court that enters from it. The general plan and location will be seen on the map, Fig. 1, together with that of all the other buildings exposed and affected in any way.

The Jenkins building was totally destroyed, as well as two 20 by 112 ft. four-story stores on the east, fronting on Liberty Avenue, and another of the same size on the west, fronting the same street. A dwelling on the opposite side of Penn Avenue was also totally destroyed. One other store on Liberty Avenue was damaged, as well as two dwellings west of the Jenkins store on Penn Avenue.

Three other buildings, which are now special subjects for consideration, were damaged in different degrees. These are James Horne & Co.'s new six story and basement department store on the corner of Penn Avenue and 5th Street, fronting 120 ft. on the former, and 175 ft. on the latter, and 112 ft. high;

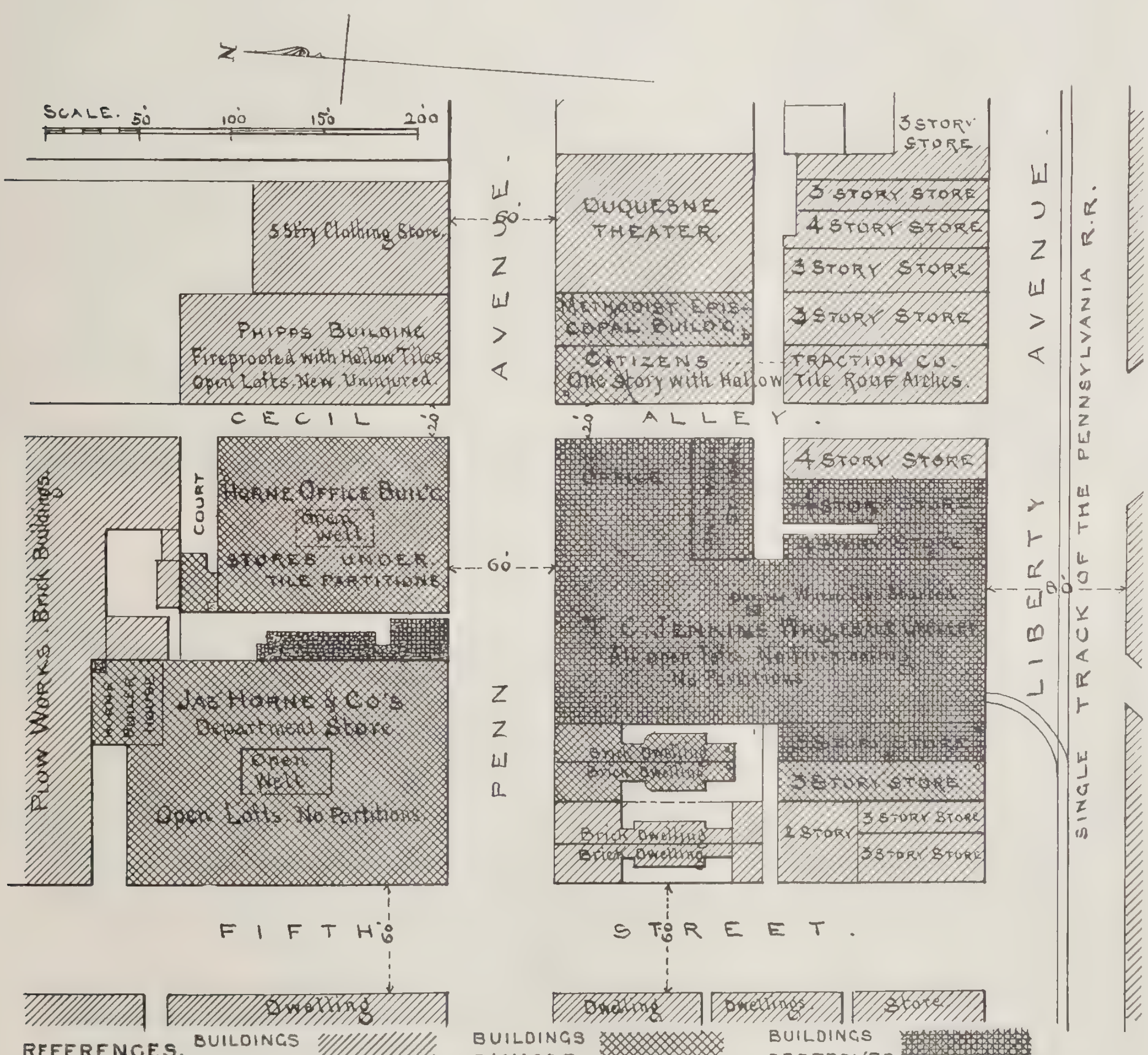


FIG. 1.—Map showing buildings at Pittsburg, Pa., affected by the great fire of May 2 and 3, 1897. The fire started near base of elevator, near center of Jenkins Building, where marked.

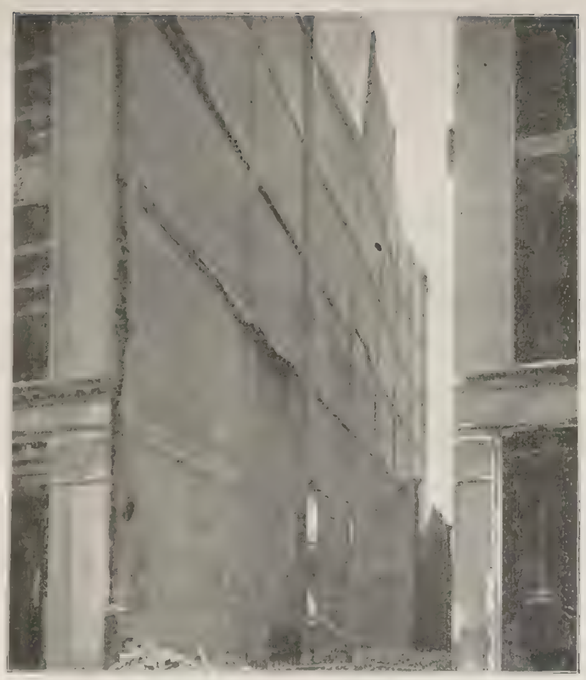


Plate 1.— Showing east wall of Horne Department Store, a steel skeleton covered and enclosed with brick, which bulged out two feet at the top, where the fall of a water tank and floor beams deprived it of lateral support

Plate 2.— Horne Department Store, showing water tank that crushed through to the first floor, carrying roof, girders, columns, and floors, as well as destroying four passenger elevators and one stairway.

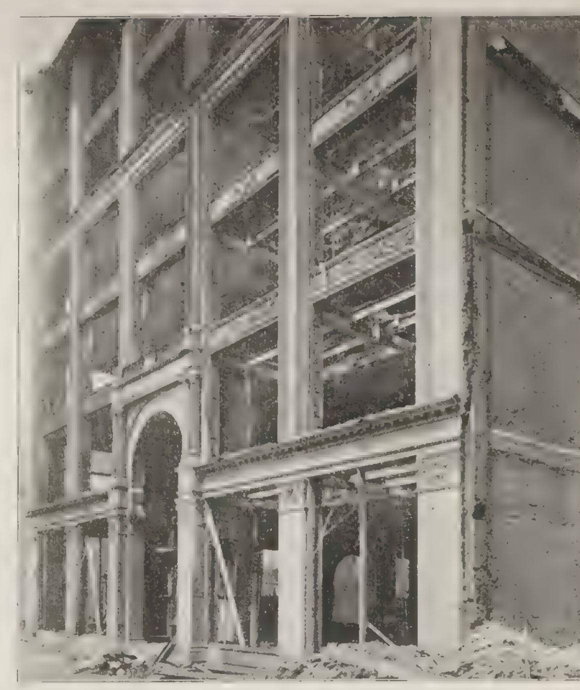


Plate 3.— Showing front of Horne Department Store and floor arches knocked out through fall of roof, caused by fall of water tank. Beams and girders uninjured except in roof.

Plate 4.— Horne Department Store, looking up through light shaft, showing general condition after fire.

Plate 5.— Side and rear of Horne Department Store, showing where riveted roof girder pulled out column in rear wall caused by fall of water tank

Plate 6.— West store on Horne Office Building, showing end-pressure hollow-tile floor arches after the fire.

PLATE 7.—Interior of Horne Department Store, looking south on third story, showing general condition of the interior and wood floor and sleepers burned completely out of the concrete ballast.

PLATE 8.— Methodist Episcopal Building with Citizens' Traction Company one-story building, where the fire stopped on the east. Ruins of Jenkins Building on the right.

PLATE 9.— Fronts of Horne's Department Store and Horne's Office Building, showing gap made in roof of the former through riveted girder, being pulled down by fall of water tank. Seen over ruins of Jenkins Building.

PLATE 10.— Horne Office Building, front room in fourth story, showing perfect ceiling tiles and damage to partitions caused by use of wooden frames.

PLATE 11.— Methodist Building, eighth floor, showing ceiling of expanded metal and plaster on ⊥ irons and partitions of wooden studs, expanded metal, and plaster.

PLATE 12.— Methodist Building, seventh floor, showing concrete ceiling and 20 in. I beams covered with expanded metal and plaster.

the four-story and basement Horne store and office building, fronting 95 ft. on Penn Avenue, and 125 ft. on Cecil Alley; and the eight-story and basement Methodist Episcopal Building, fronting 31 ft. on Penn Avenue, and running back 113 ft. to a rear alley or court. In addition to these the new six-story Phipps Building, fronting 60 ft. on Penn Avenue, and 145 ft. on Cecil Alley, was exposed to fire from the Horne store and office building, but saved by the firemen and its own steel and hollow-tile construction, except as to its broken glass windows. This building had lately been completed and was unoccupied, hence there were no goods in it to increase the risk. The building of the Citizens' Traction Company is a covered way over the tracks of the electric railroad, being the first story of what was once intended to be a high fire-proof building. It is 25 by 236 ft., cut into two sections by the alley running out of Cecil Alley. (See Plate 8.) The walls are brick, and the floor above, which also supports the roof, is of steel beams and hollow-tile arches. There is no plastering or woodwork in the building. The east wall of the north half is the base of the west wall of the Methodist Episcopal Building, which, above the first story, is pierced with windows, which have no shutters. There are, however, standard shutters on the rear, and in the wall overlooking the Duquesne Theater.

Cecil Alley is 20 ft. wide, to which, adding the 25 ft. of the Traction Company, we find that the Methodist Building is 45 ft. from the Jenkins store, on which were standard shutters. Penn Avenue and 5th Street are 60 ft. wide, and Liberty Avenue is 80 ft. wide. Accounts generally agree that there was a light wind from the south and east, to which the fire added impetus.

THE COURSE OF THE FIRE.

With the above explanation of the situation, the reader will be enabled to understand the course of a conflagration that was to put to the test some of the latest efforts of the constructors of fire-proof buildings, including architects, engineers, manufacturers, and users of fire-resisting material. Here was a huge burning structure of the most combustible character, filled with everything necessary to make a great fire, with uncovered windows on the north and south sides, and many elevators to carry the fire from floor to floor. On the north, northeast, and east were four new buildings, constructed with incombustible materials, and intended to be fire-proof, while that to the eastward had a barrier between it and the fiery furnace of the Jenkins Building, consisting of the one-story uncompleted fire-proof structure of the Citizens' Traction Company. Between this and the grocery was a 20 ft. alley, and the other four buildings were on the opposite side of a 60 ft. street. Behind two of them was an extensive plant of low brick buildings for manufacturing purposes extending to the Allegheny River. East of the group was the main business center of the city of Pittsburgh, and the nearest buildings were all of a highly combustible character, including a theater. That this group proved to be an effective barrier to the spread of fire in two directions is the universal opinion of all who saw it, is sufficient honor for those who were concerned in their erection, and a complete vindication of the modern and purely American systems of fire-proofing from the doubts and aspersions that have been cast against them. One of these buildings, the Horne Department Store, is of steel skeleton construction throughout, and is the first building of that kind ever tested by an actual fire which permeated every part of its interior. Though not as high as many others that have been built, it had conditions of exposure which it would be difficult to discover elsewhere; and while this gigantic test is a vindication of the main features of the system, it is not to be intimated that all of these buildings were without faults of construction and planning. But such faults as they have can be easily remedied in the future, and the lesson they convey is one which we now have the privilege to study and profit by. The value of burned clay in protecting steel constructions, however defectively used, has been fully demonstrated in what all admit to be a crucial test.

From information obtained from the authorities of the Fire Department of Pittsburgh, I am enabled to give some idea of the duration and severity of the test. The first alarm was given at fifty-seven minutes past eleven on the night of May 2, and the second alarm followed five minutes later. The third alarm was at 12.04 on the morning of the 3d, and the fourth at 12.33. How long the fire had been in progress before the first alarm is not fully known, and is of no special interest. It started, as has been said, near the center of the Jenkins Building and spread in every direction. In forty-three minutes from the first alarm, or at 12.40 A. M., the entire building was a mass of flames, which suddenly burst out in every direction, throwing down the entire front wall on Penn Avenue, 150 ft. in length. When it destroyed the three adjoining stores on Liberty Avenue is of little consequence, as it had no tendency to go across that street; but when it burst out of the Penn Avenue front a sheet of flame was carried across the street which drove all the firemen out of it, showing that the wind, which all witnesses said was light at first, was from the south and east. The first building to take fire on Penn Avenue was the Horne Department Store, 30 ft. of which lapped the front of the grocery house. The entire front of the Horne store and office building was exposed, but as the other one commenced to burn first, there is a further presumption that the wind was from the southeast. Between these two was an old-fashioned brick dwelling that was wiped out so quickly that no one can tell how long it took to burn. It was practically out of sight of the spectators. As stated by Chief Humphrey, in less time than it takes to tell it, every front window of the Horne Department Store, whose united surface was 60 per cent. of that of the whole front, vanished from sight, and the goods in the building seemed to take fire simultaneously on every story. The flames swept inward and roared up through the large central light court, which acted as a huge chimney for the whole. It was only the work of a few minutes to envelop in flames all the combustible contents of a building in which there were no partitions. The same results followed only a few seconds later in the Horne Office Building. The percentage of glass on the street front was about the same. In this building on the corner next to the alley was a retail crockery store, next came a retail drug store, and at the west side a store for children's dress goods. Three stories above were occupied as offices for dressmakers, milliners, and doctors. There were tile partitions between the stores and around the stairway, and between the offices on the upper stories, also around the large light hole in the center leading from the second story to the roof. But the whole of the glass in the front was burst in at one time, and the floors fired simultaneously. The contents being less combustible in the upper stories and there being many partitions, the fire did not burn as fiercely as in the department store, but as soon as it reached the light shaft *that* formed a flue which

PLATE 13.— Hallway, seventh floor, Methodist Building, showing concrete ceiling and unprotected I beam header warped by heat.

drew the fire to the center, the draft even being sufficient to keep it from the stairway, the iron work of which was preserved all the way up. The retarding effect of the partitions and the draft in the light hole kept the fire entirely out of some of the rear rooms above the second story. But in the light shaft it appeared to have been nearly as intense as in the other building.

No water was put on either of these two large buildings until the fire had done most of its work. The fire department was obliged to withdraw and re-form its lines, and by that time everything combustible in the department store had been consumed, even the wooden floors, and only the rear part of the office building was intact. There was little necessity now for water except as a preventive for the plow works in the rear, for the rear brick walls of both buildings and the standard shutters on the department store kept the fire in. The chief fixed the time of actual burning at about two hours, which allowed one hour and ten minutes to reduce everything combustible in the department store to ashes, and for fire to go as far as it went in the office building. The ruins of the grocery continued to burn until 4 A. M., when the whole fire was considered to be under control. But a duration of one hour was too long to enable the unprotected supports of the water tank on top of the department store to keep it in place. This tank was supported by steel beams and not with wood, as has been stated in some publications. But it fell at some time unknown, carrying with it the entire steel construction of girders, columns, and floors of an area of about 50 by 60 ft. of each floor, four passenger elevators, and the grand stairway. But notwithstanding this, the entire steel framework of the east wall, which was covered and filled in with brickwork, was left standing, and only the center of this wall near the top was thrown out of plumb. This is shown on Plate 1, while the interior where the greatest destruction was wrought is shown on Plate 2. The water tank is here seen hanging in the débris from the second story beams. The view is taken from the first story looking across under the light court. This tank was a closed cylinder 7 ft. diameter, and 18 ft. long, and is said to have been full of water. The shock of this fall seems to have acted on the beams of two bays of the floors all the way to the front of building, through the tie-rods, and was so great that it dislodged nearly all the hollow-tile floor arches in these sections. The beams were only saved from fire by the fact that they were left standing free with nothing combustible near them. See Plate 3 for effects of this shock. The same may also be seen on Plate 9, in which it is seen that the fall of the tank carried away the roof and ceiling all the way to the front wall. This must have been caused by the pulling of the riveted roof girders, which broke away from the front column. The iron roof beams and débris falling through may also have contributed to carrying away the floor arches. The sixth story floor beams did not give way except under the tank. It will also be noticed on the same plate that there was some defect in the method of protecting the steel lintels carrying the wall above the sixth story windows, for they all fell carrying the wall with them and leaving the roof over them. This plate also shows the condition in which the front of the office building was left. On this the lintels held and the flat stone finish was left perfect, but the copper cornice was entirely destroyed. The front bricks of both buildings were uninjured, and it is of value to note that they were made of buff fire-clay. The asphalt roofs of both buildings were unharmed except where the roof of the department store fell. Plate 5 shows the condition in which the rear and side walls of the department store were left, on which it will be seen that only the copper cornice was in part destroyed. It also shows that the two roof sections were carried away as far back as the rear wall. It is probable that the tank in falling first struck the roof girder, which being riveted together pulled off at both ends, toppling over all the sixth story columns in that stretch of girder and the rear column built in the wall. This is no argument against riveting, but a strong one against closed tanks at the top of a building.

Shortly after the front wall of the Jenkins Building fell, 75 ft. of the east wall on Cecil Alley, in which the standard shutters were closed, fell with a crash across the alley and upon the roof of the north end of the Traction Company's building,— where shown in double shading on Fig. 1 and Plate 8,— breaking down the I beams and hollow-tile arches, which were made by the Pioneer Fire-proof Construction Company, of Chicago. Otherwise these arches, which had never been plastered, were unharmed. This fall exposed the west wall of the Methodist Episcopal Building to the heat of the burning ruins, which was so intense as to communicate to all the window frames of that building above the second story. (See Plate 6.) From the window frames the fire communicated to nearly all the rooms on the west side, which were more or less damaged by the fuel that they supplied. But the hall stairway and elevator were on the east side of the building, so that the fire department was enabled to fight the fire in this building, using the hall partitions as a shield, and succeeded in keeping most of the fire out of the hall. The fire seemed to catch in each room separately, and it was only on the sixth and seventh floors that it crossed the hall partition sufficiently to work up though the stair well. At the ceiling line of these stories it wrapped around the I beam headers framing the stair openings, which were unprotected by fire-proofing, and both of the beams were bent outward, carrying the cast-iron aprons with them. (See Plate 13.) The stairway was not materially injured except at these points. In answer to an inquiry addressed to M. S. Humphrey, Chief of the Fire Department, he said that the fire continued in this building probably one hour. The firemen were in the building two hours all told.

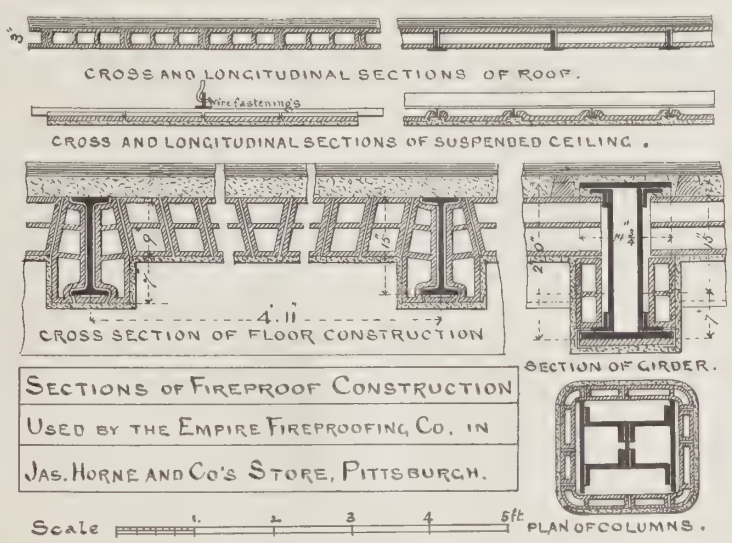


FIG. 2.

As has been stated, the active fire in all the buildings was included within the two hours from 12 to 2 o'clock. The whole department was on duty until 4 A. M., when the fire was considered to be under control. These dates are important to fix, under the circumstances. No water was thrown on the Horne Department Store, which took fire at 12.40, until nearly everything combustible in it was consumed. The firemen were then able to approach it from the west on 5th Street, and proceeded to "cool it down," to use one of their expressions. Herein I find the cause of many of the hollow tiles on the columns, beams, and arch soffits having been broken. The Chief said that very little water was used, but was free to admit that it might have been better for the building had none been used on it. It was, of course, necessary to deluge the ruins of the Jenkins Building, as in such a one there is always much unconsumed material in the ruins. They were able to approach the office building from Cecil Alley, while it was still burning, and put streams of water into it from the fire-proof Phipps Building across the alley. This building (the Horne Office Building) was also subjected to the cooling off process, but it resulted principally in breaking off the beam tiles, the end-pressure flat arches remaining intact. The power-

ful streams doubtless assisted in breaking down some of the 4 in. tile partitions (see Plate 6), which were all weakened by an industrious carpenter having inserted a flat piece of wood on top of the first course of tiles above the floor in every partition in the building.

THE JAS. L. HORNE & CO. DEPARTMENT STORE.

This building is of steel frame construction throughout. There are four rows of Z bar steel columns standing free, carrying 24 in. built-up girders, the columns averaging 24 ft. 8 ins. from centers. The floor beams average 25 ft. between bearings. They are 15 in. 50 lb. I beams, averaging 4 ft. 11 ins. from centers. The roof was of I beams carrying ⊥ irons and 3 in. book tiles, and the ceiling of light 1½ in. ⊥'s 12 ins. from centers, supporting flat tiles. Fig. 2 shows the steel and hollow-tile construction, the drawing having been made from remains in the building. The exterior steel frame is built into the brick walls. All the hollow tiles were made by the Empire Fire-proofing Company, of Pittsburgh, at their works at Empire, on the west bank of the Ohio River, about eighty miles below Pittsburgh. The work was set by them. The material is pure fire-clay, and hard burned. The walls of all the hollow tiles are generally ½ an in. thick, and only slightly thicker in the arch blocks. The Z bar columns are covered with 2 in. hollow tiles, with round corners, laid in courses of about 12 ins., eight blocks to a course. They are built as a wall around the columns without other fastening. The floor beams are covered with hollow skew-back tiles on both sides, supporting solid soffit tiles below the beams by dove-tailed bearings. The flat, hollow arches are of the side-pressure model, 9 ins. thick, abutting on the beam tiles. Each tile is divided by a horizontal web in the center into two air spaces. These arches are 5 ins. greater in span than the scale of Fig. 2 shows. There are seven tiles in each arch. The girders are covered on the bottom with solid tiles 15 ins. wide, supported by steel cramps which are exposed and only covered by the plastering. The exposed sides of the girders are covered with 4 in. hollow tiles, extending from the bottom flange of the girder to the under side of the flat arches. Dovetailed wooden sleepers were set on the tile arches, 16 ins. from centers, and filled between with 2½ ins. of ballast, made of cement and cinders. This was covered by a double wooden floor. The tile arches are very light, averaging about 35 lbs. per superficial foot.

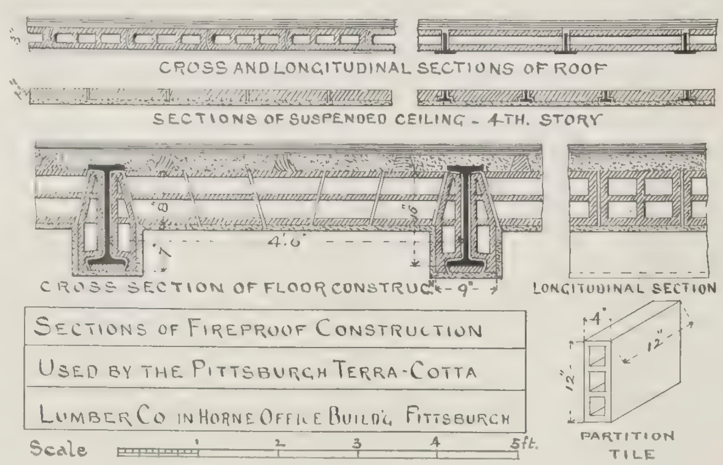


FIG. 3.

Where the fire-proofing was not destroyed by the falling of the tank and the girders, columns, roof, and ceiling which they carried down, the floor arches effectually carried the weight of rubbish remaining on them and protected the steel construction. Notwithstanding that the column covering fell from the whole length of a few columns, and from the upper parts of many others, only one steel column is said to have a slight double curvature, scarcely perceptible. The girders were all effectually protected, and no sag was observable anywhere. The ceiling and roof tiles seemed to stand better than any other part of the work, and there is no sag to either. The ceiling seems to have been a sufficient protection to prevent the exposed bottoms of the ⊥'s supporting the book tiles of the roof from sagging. In the upper stories crockery was melted, as well as cast-iron store stools; yet there is no evidence of fire having penetrated through the floors. This is not to say that the tiles themselves did not sustain considerable damage. The construction of the column covering is something not likely to be repeated. It was not secured to the columns, so that the breaking of one piece or course would let all above it fall. The main cause of the tiles falling was, however, due to the fact that there was but a very slight break in the joints on the middle of each of their four sides. This can be seen on any of the plates where the fall of plastering has revealed the joints. In many cases the middle vertical joint is almost a straight line. (See Plate 2.) Hence the slightest vertical expansion of the whole length of tiles was calculated to throw them out at the center of each column. The main injury to the floor arches was seen in the falling of the bottom plate. In most places this was only occasional, while in a few it was seen in groups; but in no place that I could find had the middle web given out. Hence the full strength of the arch was preserved everywhere. The greatest injury was to the skew-backs and soffits of the floor beams. The outer shell of the lower exposed section had flaked off in many places, but the inner shell was in most cases intact, so that the soffits fell in only a few places. In no case did enough fall to endanger the beams. The bottom plates of the girders, held up by steel clamps, kept their places with remarkable tenacity, and it was only at rare intervals that any had fallen. The tiles on the sides of girders were generally intact, and only in a few instances had the outer shell flaked off.

It is often said that wooden floors laid over concrete seldom burn, and then only in spots. In this building not only are the double floors completely burned, but the dovetailed sleepers buried in the concrete ballast of cement and cinders are reduced to ashes. And further, the ballast itself is reduced to a soft dust, and does not seem to have any of the consistency of concrete. The only theory to account for this is that combustion was set up in the unconsumed cinders.

The statement made in the report on the Denver tests that fire-clay tiles do not lose strength or consistency by reheating and throwing on water has been borne out by this experience. The cracking was evidently entirely due to uneven expansion, notwithstanding that the silly explosion theory has already been repeated. The triumph of fire-proofing with fire-clay has been reached in the Horne Department Store, in the simple fact that it has saved the steel skeleton of the first building erected under that system that has been exposed to a severe fire, and under the most unadvantageous circumstance. The predictions of croakers who claimed that buildings all of steel would be warped out of shape when protected by the modern system of light-weight fire-proofing have not been verified. These buildings looked very bad after the fire, and the photographs from which the plates are made exaggerate the apparent damage. In Plate 7, from a photograph taken on the third story of this building, can be seen its condition where the test was the greatest, showing columns, girders, floor beams, and arches, and the condition in which the floor was found. Plate 4 shows the appearance of the light court and the well-preserved ceiling and roof. The damage on the left was caused by the tank. The architect was the late W. S. Frazer, of Pittsburgh, and it was erected in 1892.

THE HORNE STORE AND OFFICE BUILDING.

This building was designed by the same architect, and erected in 1893. It has four rows of steel Z bar columns carrying double 20 in. steel girders, 16 ft. long. There is no steel in the exterior walls, all of which are brick, and there are three cast-iron columns in the first story store fronts, carrying I beam lintels. There are no lintels in the front wall above the first story except at the top of the third story windows. The front above the first story, therefore, consists of five brick piers, between which were immense wooden window frames with transoms at the third and fourth story floors, all of which have

disappeared. It would be difficult to invent a front better adapted to invite fire from across the street. The interior construction and roof were, however, entirely of steel and hollow tiles. The floors are of 15 in. 41 lb. I beams, 20 ft. 6 ins. on bearings, and 4 ft. 6 ins. from centers. The roof is of I beams carrying 2 by 2 in. ⊥'s, 16 ins. from centers, and the ceilings are carried on 1½ in. suspended ⊥'s at 12 in. centers secured to 2½ by 2½ in. ⊥ purlins. The height of the building from sidewalk is 81 ft.

The fire-proofing material throughout is semi-porous red clay hollow tiles, made and set by the Pittsburgh Terra-Cotta Lumber Company. The clay from which they are made is semi-vitreous and contains considerable "grog" or ground brick and tiles. It is not porous terra-cotta in the strict sense, as to be thus called it should be made with an equal bulk of sawdust. Sufficient sawdust has, however, been used to make it burn tough, and to only slightly reduce the weight. The walls of the tiles are about ⅞ in. thick, though in many places solid 1½ in. tiles are used, as around the columns and in the suspended ceiling over fourth story. The fire test in the building showed that heating, wetting, and cooling did not destroy the structure of the material, as is sometimes the case with very light porous terra-cotta made of plastic fire-clays.

The method of fire-proofing the girders was not evident, as none of them were exposed. The columns all come in partitions, and where exposed are covered with 1½ in. slabs of the above material, not fastened in place other than by mortar, a few of which have been displaced. The illustration (Fig. 3) shows the other methods of fire-proofing used in the building, measured and drawn from the work itself, as no other drawings were attainable. The floor construction is similar in general shape to that of the Horne Department Store, but different in details. It is of end-pressure flat arches, and this is the first actual fire in which they have ever been tested. Each beam is covered with a skew-back tile on both sides supporting a solid soffit tile between dovetails at the bottom. The floor arches are of end-pressure tiles in five pieces. Each is cut from a rectangle of 8 by 12 ins., with two crossing webs, leaving four holes in each tile. Hence each tile is 8 ins. thick and 12 ins. wide, and the whole arch is 8 ins. thick, 1 in. less than those in the other building, but, I should judge, much heavier. To the honor of this material be it said that I could not find any arch displaced or the bottom of any tile broken off. The floors had the two air spaces available to the end of the fire. The same cannot be said of the skew-back beam coverings, for though they thoroughly protected the beams, the exposed corners of many of them were broken off, and some of the soffit tiles had fallen. This is shown on Plate 6, from a photograph taken from the street looking into the west store next to the stairway entrance. This is the store that sustained the greatest heat. It shows all the excellences and defects of the work in this building. It will be seen that the hall partition has fallen. This was doubtless done by a powerful stream of water, for it is just where one from the east side would strike. The insertion of the unfortunate wooden strip at the bottom of the partitions made them weak against any lateral force. It should be said, too, that this was the only partition of much size that fell. In other places all the partition tiles that were dislodged were around the halls in the upper stories where so much woodwork was used. None were really destroyed by the action of fire, but through other circumstances, for which the fire-proofer was not responsible; the tiles simply fell down. The floors throughout were built on top of the arches, as in the other building. The ceiling of the fourth story was unharmed by fire. The same can be said of the book tile roof. The asphalt covering of the roof was intact, but the galvanized iron skylight over the light court was completely destroyed, and hardly anything remained to show that it had been there. The steel-trusse framework for the skylight was standing, complete, and apparently unharmed. Plate 10, taken from a photograph of one of the front rooms of the fourth story, looking into the hall, shows the worst condition of the partitions in the upper part. The door and hall window of the hall partition have been reduced to one opening, and all the tiles supported by woodwork have fallen. The ceiling is shown intact. In the lower part of the partition on the left can be seen the place where the carpenter had put his usual strip. It has been said that this building was not subjected to as great a heat as the department store, but the whole front of it was exposed to the Jenkins Building. Plate 6 shows a store which was filled with just as combustible goods as the department store, in which nothing remains to be seen but hollow tiles, and in Plate 10 there is evidence of intense heat, and complete destruction of everything combustible. Yet in several of the rear rooms the contents were saved. The value of semi-porous tiles was completely demonstrated in this fire.

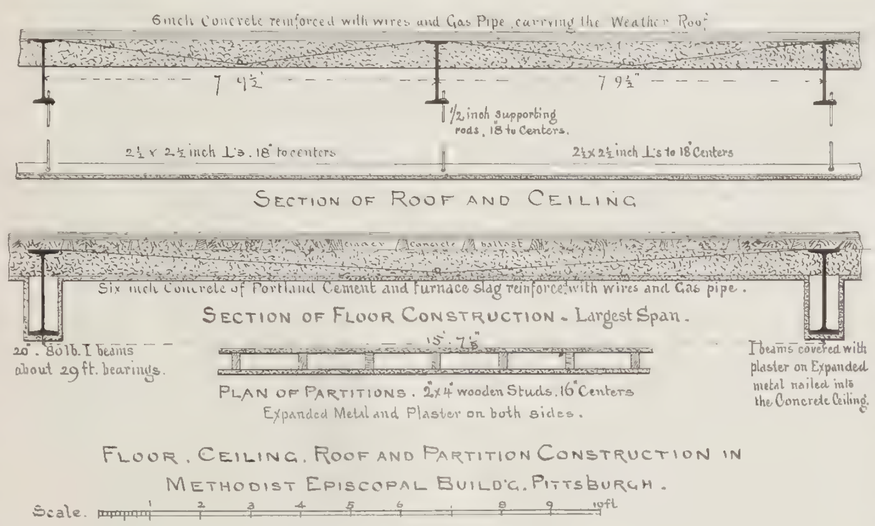


FIG. 4.

THE METHODIST EPISCOPAL BUILDING.

This eight-story and basement building was built with exceptionally heavy walls, and without steel construction except for the floors and roof. The walls on both sides in the first and second stories are 28 ins., in the third and fourth 22 ins., and in the fifth, sixth, and seventh, 18 ins. The eighth story wall on the west side exposed to fire is 18 ins., and on the east side 13 ins., with 18 in. piers to carry the I beams of the roof. The floor beams throughout are generally 20 in. 80 lb. steel, 29 ft. on bearings, and the greatest spans between beams are 15 ft. 7⅛ ins. The roof is of 15 in. I beams not more than 8 ft. from centers, to which are suspended by ½ in. rods 2½ by 2½ in. ⊥'s 18 ins. from centers, to which is attached expanded metal, plastered. Fig. 4 shows the general construction of floors, ceilings, roof, partitions, and beam covering. Plate 11 shows a room on the eighth story, looking toward the front, with ceiling plastered on expanded metal, and expanded metal and plaster partitions on wooden studs. This room with the two private rooms seen through the doors were the offices of Charles Bickel, the architect of the building. Plate 12 shows the room on the seventh floor immediately under it, with suspended concrete ceiling. Two sections of the concrete ceiling, and also of the floor of this room, sag between the beams from 2 to 3 ins. In other parts of the building which were not burned some of these sections have a permanent sag of about 1 in. Plate 13 shows a view of the hall immediately outside of the last-mentioned room. The center rooms of the sixth story were also damaged about the same as in the seventh. The damage to the fifth story was mainly in the front rooms.

This fire, in such a remarkable location, is not without its lessons to all who are interested in the use of clay materials. These will form the basis of some future suggestions.

Mortar and Concrete.

AMERICAN CEMENT.

BY URIAH CUMMINGS.

CHAPTER VII.—(*Concluded.*)

CEMENT TESTING.

THERE is no one feature connected with the subject of cements which exerts a stronger influence in the building up of opinions concerning the qualities of a cement than that of color.

The belief is almost universal that a good dark color is a sure indication of a good strong cement.

The tester is an exception who does not express surprise when he finds a light-colored cement testing higher than a dark one; and he almost invariably attributes the cause to some defect in his dark briquettes.

If he should be told that the way it came to be discovered that the world was round, and revolved on its axis, was by observing that people who did much walking in easterly and westerly directions invariably ran the heels of their shoes down at the back, while those who wore theirs off at the sides were found to do most of their walking in northerly and southerly directions, he would feel that his intelligence had been called in question; but it would not occur to him that his own theory in regard to the color of a cement was equally as whimsical.

It is remarkable how strong a hold some absurd prejudices have upon the general public.

It was not so very many years ago that any brand of Western flour, to obtain a market in the Eastern States, had to be put up in round-hooped barrels.

For more than a third of a century it has been repeatedly stated that the color in a cement was due to the presence of a small amount of oxide of iron, and that in no manner did its presence affect the quality of a cement.

General Gillmore so stated it in his treatise on "Limes, Cements, and Mortars," issued thirty-five years ago; and the same statement has been made by various writers during all the subsequent years. Yet the belief prevails that color has to do with the quality.

So strong is this prejudice, that manufacturers of Portland cements, when they find that their available clay does not carry sufficient oxide of iron to give the requisite color to their product, resort to the use of artificial coloring matter, on account of the difficulty experienced in finding a market for light-colored Portland.

Any coloring matter, whether in a natural or an artificial cement, is an adulteration, and is inherent in the Rock cements, while it may or may not be so in the artificial product.

In the Rock cements the oxide of iron is closely associated with the clay, and its quantity, as a rule, governs the shade of coloring given to the cement.

If the amount is small and the calcination is light, the color of the cement will be a pale yellow. But with a higher degree of calcination, the color becomes a deeper yellow, or a light or a dark drab, dependent upon the intensity and duration of the heat.

If the amount is large, the cement will be light to dark brown, according to the intensity and duration of the heat.

Whatever may be the color of a cement, its quality is in no way affected thereby, unless the amount of coloring matter is excessive.

The quality of a cement is governed by three important requirements, no one of which can safely be dispensed with, namely: —

First, a proper proportion of the essential ingredients, *i. e.*, silica, lime, magnesia, and alumina.

Second, a proper calcination, which must be varied to suit the requirements of varying proportions of the constituent parts.

Third, fine grinding.

It will be seen, then, that a cement may be either light or dark, and yet be of good quality, while a very poor quality of cement may be accompanied by the most taking shade of colors.

And yet, inasmuch as the constituent parts named, when free from impurities, are white, it cannot but be clear that an absolutely pure cement cannot be otherwise than white.

The Rock cements are never colored artificially, and so we find as many variations in color as there are different manufacturing centers, each having its own peculiar shade or tint, while the different brands of the same locality are usually of the same color, yet they may vary considerably in quality.

With the artificial cements, the natural coloring matter is to be found in the clay, the same as with the Rock cements, and, as has been stated, when this is insufficient to suit the prevailing taste (?) resort is had to artificial coloring by the use of some form of carbon, or pigments.

Though the appearance of Portland cement, unadulterated with extraneous coloring matter, is an indication of its merits, it is clear that if artificial coloring matter is employed, the appearance of the cement is no criterion of its quality.

TENSILE TESTS.

The system of arriving at the value of a cement by means of the tensile strain testing machine has grown to such proportions, and is so universally relied upon, believed in, and so seriously regarded as the Ultima Thule of all the knowledge necessary to determine values, and make or unmake a cement in the public opinion, that it seems almost sacrilegious to disturb the serenity of the faithful followers of this modern Juggernaut, who, metaphorically, throw themselves under its sacred wheels.

And yet the system is so permeated with inaccuracies, inconsistencies, and absurdities, that the temptation to puncture the venerable humbug is well-nigh irresistible.

The system contains many features in common with the alleged virtues of the divining rod.

And, although the comparison may seem odious to a large majority of the champions of the tensile test system, yet the author feels measurably assured that a few, at least, of the undoubted facts which he may present will be recognized at sight by many engineers and architects whose experiences with the system have led them into labyrinths of uncertainty and doubt.

The following from a paper on "The Divining Rod," presented by R. W. Raymond at the Boston meeting of the American Institute of Mining Engineers, in February, 1883, is sufficient to illustrate the parallel: —

"First. The immense literature of the divining rod shows nothing more clearly than the boundless confusions and contradictions of its advocates and professors.

"Second. Of the dozen different schools of practise, each is necessarily obliged to reject half of the asserted principles and certified facts put forward by the rest.

"Third. It will be remembered that the Egyptian sorcerers confronted by Moses carried rods, as Moses and Aaron also did.

"Fourth. Cicero, who had himself been an augur, says, in his treatise on divination, that he does not see how two augurs, meeting in the street, could look each other in the face without laughing.

"Fifth. The following formula, cited by Gaetzschmann, may serve as an example: —

"'In the name of the Father, and the Son, and of the Holy Ghost, I adjure thee, Augusta Carolina, that thou tell me how many fathoms is it from here to the ore.'"

One has but to consider that if a package of any brand of cement is divided among fifty expert testers, to be made up into briquettes, all the testers being governed by one set of rules, as to time, temperatures, percentage of water to be used, and the other ordinary requirements, the breakings, when tabulated, will show fifty tables of tests, no two of which will be alike. In fact, they will vary from each other all the way from 1 to 300 per cent., and so, if in the first para-

graph of the quotation we insert "tensile tests" in the place of "divining rod," we come near to describing the present chaotic state of the art of briquette making, and, in the fourth paragraph, in the place of "two augurs" read "two testers," after they have stood side by side at the same table, and have each made and tested five briquettes from the same sample of cement, and find the results from 50 to 200 lbs. apart.

And as to the fifth paragraph, let us read it thus, "In the name of the American Society of Civil Engineers, and all the other societies under the sun, whose members practise the art of cement testing by tensile strain, I adjure thee, O thou testing machine, to tell me whether it is thy fault that I am thus befuddled, or am I drifting into incipient idiocy."

A tester makes up briquettes and tests them from a given brand of cement, and reports to his superior that "the cement runs very uneven." The fact that it is his briquettes and not the cement which "runs very uneven" never occurs to this knight of the testing machine.

When Don Quixote made his famous charge on the windmills and was unceremoniously overthrown, he had the courage to beat a rather undignified retreat.

But not so with our knight of the testing machine. He may be overthrown day after day, but he does not know it, and with an assurance bordering on the sublime he will tell you that such and such a brand of cement is not first class, for he has tested it, and the cement is not up to the requirements, for it "runs very uneven."

It is useless to confront him with the fact that other expert testers have found that the brand in question tests above the requirements, for, lacking the prudence of Don Quixote, he is overthrown, but does not realize it, when he says he "can get now and then a briquette to come up to or even go beyond the requirements, but it will not average (?) more than as shown in his tables."

It is probable that we are indebted to the engineers of a past generation for that altogether brilliant idea of giving a brand of cement a record based on its average (?) breakings. And for some unaccountable reason its utter absurdity seems to have escaped the notice of the ablest engineers of to-day.

If a trotting horse should be sent to the track, on a trial of three one-mile heats, for the express purpose of making a record, and the three trials should result as follows:—

	min. sec.
1st heat,	2.15
2d „	2.20
3d „	2.10
total time	6.45

would we calculate the time thus, $6.45 \div 3 =$ average time 2.15, and seriously contend that the horse takes a record of 2.15?

Should this be done, the whole trotting world would smile, and yet it would be no more absurd than it is to give a cement a record based on the average (?) result of breaking strains of three or five briquettes, made from the same sample of cement.

The tester makes three briquettes from a single small sample of cement, and no one will deny that it is precisely the same in all its parts, and to the best of the tester's knowledge and belief, he has made the briquettes precisely alike. He has treated them alike as to every known detail, and yet one breaks at 100 lbs., while the others fall off 30 and 60 lbs. respectively, and the engineer, while knowing these results, from habit or custom, permits the cement to be deprived of its just record, which in this instance is none other than 100 lbs., and the record is fixed at 70 lbs.

If one portion of the sample tested 100 lbs., surely it is not the fault of the cement that the balance did not, and the conclusion is inevitable that it is the tester who is at fault. But the fault is laid to the cement, and so this inanimate though wonder-working material suffers in reputation by the carelessness and blunders of the average knight of the testing machine.

During the construction of the new Croton Aqueduct at New York, a certain brand of Rock cement was tested in one-day neat tests by two sets of testers,—

835 briquettes made by one set of three testers averaged $62\frac{3}{10}$ lbs.
2434 „ „ „ „ ten „ „ $85\frac{2}{10}$ „

a difference of nearly 35 per cent., and yet one set of rules governed all the testers, and the tests were made daily from the same consignments of cement.

From the table of tests of Mr. Thompson, City Engineer, Peoria, Ill., as shown in connection with his specifications as herein given, the following are selected from a large number, as a fair example of one-day neat tests of Rock cement.

No.	No. of Samples.	Highest.	Lowest.	Average.	Per Cent. Variation.
1	8	118	45	77	162
2	6	138	80	109	72½
3	6	104	65	79	60
4	10	103	47	65	119
5	5	142	50	79	184
6	8	143	48	70	198
7	9	141	57	122	145
8	8	167	80	140	108

Mr. Thompson's tables contain the unusual merit of showing the highest and lowest breakings.

The absurdity of giving a cement a record on the average (?) system is well demonstrated in No. 6 of the table.

The eight samples were made from the same cement. One of the briquettes happened to be well made, and it tested 143 lbs., and yet it takes a record of barely one half that figure. It is deprived of its just and true record presumably because the briquette maker, when he made the one which tested only 48 lbs., was either very tired, or careless, or was unduly hurried.

The table given is not an exceptional one. Tables as uneven as this are to be found in nearly every cement-testing establishment in the country, and it has always been so since the tensile test mania began, over a third of a century ago.

The prevailing practise in the making of briquettes is to apply sufficient water to produce the proper degree of plasticity, thereby enabling the operator to press the material into the molds with the thumbs or a trowel.

This method is supposed to attain medium results, and is advocated by engineers generally, under the impression that the breakings of such briquettes indicate quite closely the actual strength of the cement in the masonry in which it is used.

However true this theory may be, it opens the door to a wide diversity of results, as each briquette maker is a law unto himself as to what constitutes the proper degree of plasticity of the material; and herein lies the chief cause of the surprising difference in the strength of briquettes made up from a single sample of cement.

The author has for many years been firm in the belief that the only correct way to test a cement by tensile strain is to use just enough water to properly hydrate the silicates, then pack the material into the molds, making the briquettes as dense and solid as is possible, by tramping or ramming, the object being at all times to make the briquettes test to the utmost limit of the strength of the cement. We would then know the capabilities of each brand tested.

There is a satisfaction in knowing the full strength of a cement whether or not it is ever called into practise in masonry.

Once the full strength of a cement is known, it becomes an easy matter to estimate the strength values of different degrees of plasticity.

By this method we avoid the contradictory and unsatisfactory variations which continually arise among different testers of the same brand, which will always obtain so long as moderate results only are aimed at.

So long as the qualities of our cements are to be measured by tensile strain tests, there is no good reason why the system should not be open to improvement.

If it is self-evident that to the system of aiming at moderate or

medium results is due the variations which are often so wide as to be really grotesque, why not abolish such a system and adopt that which will give us without question a full knowledge of the highest limit of strength in the cement, and at the same time reveal to us all its capabilities? And, instead of giving a cement a record based on the average breakings of five briquettes, a most absurd and indefensible system, let the highest testing briquette of the five make the record of the cement.

It is only by the employment of this system that the question of the relative strength of different brands of cement can ever be settled.

It is the only system that is fair to all brands of cement. This is shown by the wonderful uniformity of breakings of briquettes made from any brand of cement where the aim has been to get the highest possible results.

In nearly all the tables of tests that are published where the records of several brands of cement have been carried along for any length of time, it will be observed that one or more of the brands will fall off in a most inexplicable manner.

Perhaps the records are higher at three months than they are at six, or even nine months, and yet at twelve months they may have recovered all the lost ground, or even have made a substantial gain; and so we often notice in long-time tests that a cement may show a strength of, say, 500 lbs. at one year, and 400 lbs. at two years, while the three years' column will show 600 lbs.

This uncomfortable feature is common to the Rock and Portland cements alike.

Should such an uneven showing of one brand be recorded in a table among other brands which show a steady gain, the comparison is naturally unfavorable to the one with the unsteady record.

In fact, it is not at all unusual to meet with those in authority who will unequivocally express a preference for the cement showing the more steady record, even though the brand which has fallen off may have surpassed all the others at the final closing of the table.

The explanation for this curious phase of the subject is found in the deep-seated and profound faith in the infallibility of the testing machine.

If three briquettes are made from a single sample of cement by one person and they are treated alike until broken at six, nine, and twelve months, and the breakings are 500, 400, and 600 lbs. respectively, nothing is more certain than that the briquette which was broken at nine months was not as well made as the others.

If a cement is really weaker at nine months than it is at six months, it is simply impossible for it to show any gain in the twelve months' test.

The absurdity of a cement gaining and losing in strength alternately must be apparent to any person who will study the cause of its setting and hardening.

In the testing of cements by tensile strain the engineer meets with many conditions which seem to puzzle and confuse, among which may be noted that it oftentimes happens in the testing of two or more brands of cement neat, and in sand mixtures, that although the brands may be equal in fineness, the same quality of sand used for all, and all the briquettes made by the same person, yet the cement which tests the highest neat tests the lowest in the sand mixtures.

Rarely more than one set of tests is made, and so the tables are made up, and it is recorded against the highest testing cement that it "tests high in neat tests, but cannot carry sand equal to the lower testing brands."

This is a condition which often confronts the engineer, and, strangely enough, the opinion formed is almost invariably adverse to the brand testing the lowest with sand mixtures, although showing the highest in the neat tests.

In ninety-nine cases in every one hundred the opinion would be corrected by further tests, for it is certain that all conditions being equal, the cement testing the highest in neat tests will also test highest in sand mixtures, and the failure to do so may be looked for in the imperfect manner of making the briquettes.

The only possible exception to the rule will be found in the fact that a cement containing an excess of clay may test high in neat tests, yet will not carry sand equal to one that is correctly proportioned.

But such cements are so exceedingly rare in this country that the rule may be said to hold good, that the fault is in the making of the briquettes.

There are thousands of masons and contractors throughout the country who buy and use cements, in the construction of cisterns, cellar floors, sidewalks, milldams, foundation walls, and for various other purposes, who have no mechanical means for testing the cements they are using.

To such we suggest the following method.

Although the process is very simple and easy to practise, yet it involves a principle which embraces the chief and most valuable features of all other tests.

In fact, it may be said that there are no known methods for testing the hydraulicity of a cement which for effectiveness and reliability can compare with it.

The author has employed this method, whenever occasion has arisen, during the past thirty years, and he has never known it to fail to detect and expose weaknesses or imperfections, if they exist in the cement.

In the practise of this method it is only necessary to make a mold with which to form bars of cement.

All that is necessary for this purpose is a piece of hardwood plank 3 ins. wide, 2 ins. thick, and 12 ins. long.

Mortise into one side of this bit of wood a cavity 1½ ins. wide, 1 in. deep, and 8 ins. long, making the sides and ends slightly beveled, which, with the bottom, should be made smooth, and then the cavity should be well oiled, after which it is ready for use.

Wet up a sample of the cement to be tested into a stiff paste, and with a trowel press it in firmly, and smooth it off level with the face of the mold.

After the cement has hardened, which will occur in from twenty minutes to two hours, turn the mold bottom up, and let it rest on supports ½ in. thick under each end.

By careful jarring the cement bar will drop out of the mold.

Place the bar on the broad side in a pan or box, with the ends resting on supports in such manner that at least 6 ins. of the length of the bar shall be free and clear underneath, with a vertical clearance of 1 to 2 ins.

Next, fill the receptacle with water until the cement bar is completely submerged.

If the cement is strong in hydraulicity, the bar will maintain its shape indefinitely; but if it is lacking in this quality, or is weak, or defective in its composition or manufacture, it is sure to give way between the supports.

The author has known of rare cases where the bar maintained its shape ten days and then collapsed, but the ordinary defects in a cement will be made manifest within twenty-four hours.

Bars made with sand mixtures, of course, require a longer time to harden than those made from neat cements, and, therefore, should be given a full opportunity to crystallize before submersion.

In closing our chapter on the testing of cements, the thought arises, which, although somewhat tinged with impertinence, will not be dismissed without expression.

In our first chapter we quoted from "Hydraulic Mortars," by Dr. Michaelis, Leipzig, 1869, as follows: "The Eddystone Lighthouse is the foundation upon which our knowledge of hydraulic mortars has been erected, and it is the chief pillar of our architecture."

This sentence covers a great deal of ground, and is worthy of much thought and consideration; and granting that it is true, we are lost in conjecture as to what John Smeaton would have done when he built the Eddystone Lighthouse, had the cement which he used in

the construction of that famous tower been passed upon by a British government engineer, with a tensile strain testing machine as his guide, and governed by the absurd rules and specifications, for this cement could not possibly have tested 25 lbs. per square inch in a seven-day neat test.

What would be thought of the manufacturer of to-day who would have the temerity to offer such a quality of cement for the construction of a lighthouse in this country or in Europe?

Everybody knows he would be ridiculed, for it is a question if Rock cement testing 150 lbs. in seven days would be considered strong enough, and it is more than likely that a Portland testing 400 lbs. in a seven-day neat test would be required.

Yet the Eddystone Lighthouse stood in good condition over one hundred and twenty years, until taken down to make way for a larger structure; and the mortar was found all that could be desired.

This being true, what becomes of our boasted advance in the art of cement making?

Where can we find a more trying place for a cement mortar than in the stone walls of a lighthouse standing out in the open sea?

Wherein lies the benefit of using a high-testing cement for such work, when a cement of the quality of the Aberthaw hydraulic lime used by Smeaton in the walls of the Eddystone Lighthouse can be supplied in this country for less than one fourth the cost of the high-testing cement?

If we care to build for all time, we must remember that that which causes a cement to set promptly in water also causes its comparatively early disintegration when exposed to the atmosphere.

A cement, therefore, which requires sixty or ninety days to harden in exposed masonry will be found in perfect condition ages after the mortar made from quick-setting cements has crumbled out and disappeared.

The investigations of Professor Tetmajer, of the Federal Polytechnical School, at Zurich, developed the fact that some German Portland cements, when used in work exposed for several years to the air, lose their consistency and crumble.

So serious had this danger become that, only a few years ago, the German Minister of Public Works issued a circular restricting within narrow limits the use of Portland cement in work exposed to the air.

Professor Tetmajer found, after careful examination, that the cause of the disintegration of Portland cement exposed to the air is found in a want of proper preparation of the materials, particularly in the lack of sufficient grinding together of the chalk and clay to insure the complete silification of the lime during the process of calcination.

He also found that the best brands of German Portland cement which had withstood the action of water for several years became soft on exposure to air.

He says, also, that "air especially attacks sharply (hard) burnt cements, which imbibe a great deal of carbonic acid, and the decay in water is caused by an excess of matters which undergo an increase in volume by oxidation and imbibing of water."

What, then, can justly be claimed as an advance in the art of cement fabrication since the days of Smeaton, one hundred and forty years ago?

We have managed how to make a cement which will set hard in much less time now than then, but at the expense of endurance and this is, practically, all that has been learned.

The cement world of to-day is wrought to a high pitch in the matter of high short-time tests. The pendulum has swung in that direction without let or hindrance. But it will start on its return as soon as sufficient time has elapsed to prove beyond question that a cement may test too high, that all tests above the medium are developed at the expense of endurance.

And so there are those living to-day who will witness the passing of the high-test craze, and who will smile when they read of the conditions surrounding the testing of cements during the latter half of the nineteenth century.

The Masons' Department.

STRAINS IN ARCHES. I.

BY JOSEPH MARSHALL.

IN order to sustain any load over a void, between two supports, we have only four means available: (*a*) the lintel; (*b*) the arch; (*c*) the suspension cord or arc; and (*d*) the cantilever. In the lintel we have two forces in the same body — compression and tension. The relative areas of the body composing the lintel which are subject to these opposite forces at any one time, or in any one instance, must depend upon the nature of the material of which the lintel is composed and upon the force of the load borne. As a result we have what we call the *transverse strain*, which is only the offspring of the two opposing forces of compression and tension, both in operation at the same time in different parts of the same mass. It follows, therefore, that the highest efficiency is obtained from a lintel when the molecules of the matter of which it is composed possess a high degree of cohesion among themselves, and a high degree of resistance to compression. From these two qualities result *rigidity*. The lintel then derives its usefulness from this quality of rigidity.

The arch, on the contrary, has all its parts in a state of compression, and, therefore, only one kind of strain in operation in the masses of which it is composed. But because it is composed of several masses whose relations of cohesion to each other depend mainly on the gravity of their individual masses, there necessarily exists in the arch, as a construction, a high degree of pliability. So that while the lintel is wholly in transverse strain the arch is wholly in compression. But accompanying the arch and inseparable from it, as a construction, is this dangerous quality of pliability. While the office of the arch and lintel are the same, the manners of discharging the functions are different — their physical properties, and the effects produced upon their respective supports, are different. The lintel discharges all the force of the load borne, vertically upon its supports, and exercises no disturbing influence in a lateral direction. The arch conveys the whole force of the load borne to its supports, but at the same time exerts a lateral pressure tending to disturb their verticity, although not always in the same direction, yet, as generally used, tending to drive them apart.

It is of no importance, in considering their relative properties, whether an arch be perfectly horizontal, or a lintel be of any degree of curvature which an arch might exhibit, the physical properties of each remain quite unchanged. It is quite conceivable that a lintel might be made of a semicircular or other curved form to span a void and rest on two distant supports, yet while it may look like an arch and fulfil the office of an arch, it would still be nothing more than a curved lintel. On the other hand, an arch could be built so as to present horizontal boundary lines at top and bottom (as lintels usually do), but if it were composed of more than two distinct pieces which, by their collective relations and gravity, retain their position in place, *it is an arch*, although it may *seem* to be a lintel.

An arch, then, is definable as: An assemblage of not less than three pieces of any firm material so arranged in position that by their contact with each other, and their inherent gravity, they retain their relations of place and position so as to form a continuous structural way impending a sub-transverse void, and having support at its extremities only.

It is not necessary that such a structure should present to view in any part or particular a curvilineal form — such characteristic being incidental to convenience only.

In order to the better understanding of what we may say later, we will here divide arches into their natural classification.

All arches, of whatever form, are comprehended in two classes.

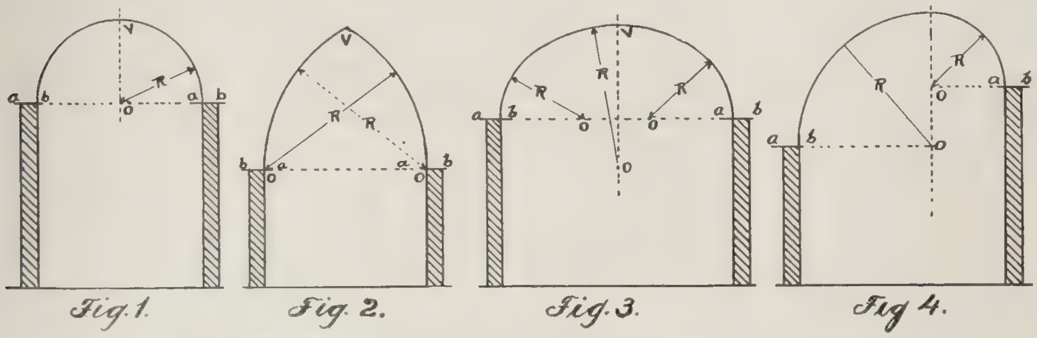
In three articles which will be published in consecutive numbers of THE BRICKBUILDER, Mr. Marshall, who has made an exhaustive study of the subject will give briefly his theory regarding the "Thrusts and Strains in Arches."— EDS.]

First, all arches springing from horizontal planes. Second, all arches springing from inclined planes.

In each of these classes there are four distinct varieties: —

FIRST CLASS. *a.* Arches springing from horizontal planes the arcs of which are described from one center, and which attain their apex or maximum altitude (the highest point of the intrados) at a point vertically over the center of the arc. See Fig. 1.

b. Arches springing from horizontal planes, the arcs of which are described from two or more centers, and which attain their apex at a point to be determined by the intersection of their arcs. See Fig. 2.



a b horizontal planes; *o* centers of arcs; *r* radius; *v* apex or highest point of intrados.

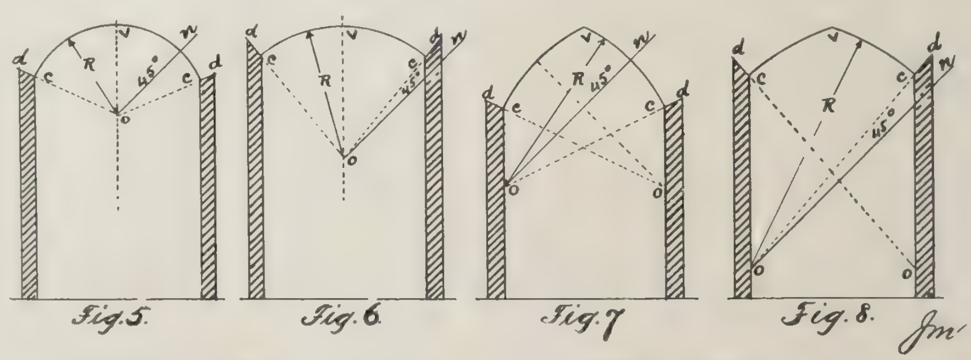
c. Arches springing from horizontal planes, the arcs of which are described from three or more centers, only two of which are located on the horizontal line from which the arches spring, and which attain their apex vertically over the center of the span. See Fig. 3.

d. Arches, springing from horizontal planes, the arcs of which are described from two centers in the same vertical line, and which attain their apex at a point in the same vertical line in which their centers occur. See Fig. 4.

SECOND CLASS. *a.* Arches, the arcs of which are described from one center, springing from inclined planes, situated below the point where a line drawn at an angle of 45 degs. of elevation from the center of the arc would intersect that arc, and which attain their apex at a point vertically above the center of the arc. See Fig 5.

b. Arches, the arcs of which are described from one center, springing from inclined planes, situated at or above the point where a line drawn at an angle of 45 degs. of elevation from the center of the arc would intersect the inner line of the supporting pier, and which attain their apex at a point vertically over the center of the arc. See Fig. 6.

c. Arches, the arcs of which are described from two or more centers, and which spring from inclined planes, situated below the point where a line, drawn at an angle of 45 degs. from the centers of the arcs, would cut the arc, from whose center it is drawn, and which attain their apex at the point where the arcs intersect. See Fig. 7.



d c inclined planes; *o* centers of arcs; *r* radius of arcs; *v* apex or highest point of intrados; *o n* the line drawn at an angle of 45 degs. elevation from the center of the arc to intersect the arc or the inner line of supporting pier, as may be.

d. Arches, the arcs of which are described from two or more centers, and which spring from inclined planes, situated above the point where lines, drawn at an angle of 45 degs. of elevation from the centers of the arcs, would intersect the inner lines of the supporting piers, and which attain their apex at the point where their arcs intersect. See Fig. 8.

Each class and variety has inherent elements of action peculiar to itself, but all are comprehended under one unchanging law.

It has been usual, we believe, to consider that all arches begin to exercise their *thrust* force at the *springing line*, and we believe most commentators on the arch take this for granted, and begin by assuming this premise to be correct. But from our investigations we are led to believe that this assumption is erroneous as a general law, but quite correct under certain circumstances. Hence, it is at best but misleading. Some forms of arches, although bound together at the springing line by sufficient force to prevent spreading of the supports *below* the spring line, could, nevertheless, be quite completely overthrown *above* the spring line by placing sufficient load at or about the crown. It is true that the force required to accomplish this result would be much greater than if the same arch was mounted on piers of greater or less height, and the reasons, therefore, we shall endeavor to present in future chapters.

In all our means of spanning voids, considering each contrivance as a whole, there seems to be no real difference in the manner of applying forces to resist gravity — tension and compression being the two forms of its application to matter. Indeed, it is exceedingly doubtful if force can be otherwise applied to matter.

We have observed that in the lintel one part was in compression while the other was in tension. This is equally true of an arched structure, *i. e.*, the arch and its piers, though not true of the arch itself. All parts of the *arch* are in compression, but the resistance of the piers is the equivalent of tension; indeed, it is the *evidence* of tension. A truss, no matter how elaborate, is only a constructed lintel, which has, like the monolithic lintel, its tension and compression within itself, differing from the arch, which has its compression within itself and its tension in its piers. The suspension cord is the reverse of an arch, being all in tension, but demanding the complement of compression from its supports. A cantilever is an arrangement of three trusses, or lintels (supplemented with gravity counterpoise), so arranged that two of them have their tension parts uppermost, and in opposite position from the third.

FROM THE BENCH.

LIABILITY OF ASSIGNEE OF BUILDING CONTRACT.—Where an assignment of a building contract as collateral security for a loan required the assignee to pay all moneys received on the contract to the assignee, and the assignee to apply them to the payment of claims arising under the contract, the assignee was not liable for the payment of such claims beyond the amounts so received.— *Supreme Court, Penn.*

CONTRACTOR MAY HAVE FRAUDULENT CONVEYANCE SET ASIDE.— A contractor having a mechanic's lien may sue to set aside as fraudulent a conveyance of the premises by the owner. His standing, said the court, is not that merely of a general creditor, who must first obtain a lien on the property of the debtor by the recovery of a judgment and issue of execution. His lien is perfect on complying with the requirement of the statute, and it is a specific lien on the particular property, similar in all respects to a mortgage.— *Supreme Court, N. Y.*

Recent Brick and Terra-Cotta Work in American Cities, and Manufacturers' Department.

NEW YORK.— The most interesting event during the past month was the signing of the Greater New York charter by Governor Black.

A few facts regarding the extent of Greater New York may be of interest to our readers. The new city will cover 359.75 square miles. Its population will be 3,200,000. Length, 35 miles. Width, 19 miles at widest point.

There will be 167,000 buildings, of which 130,000 are residences.

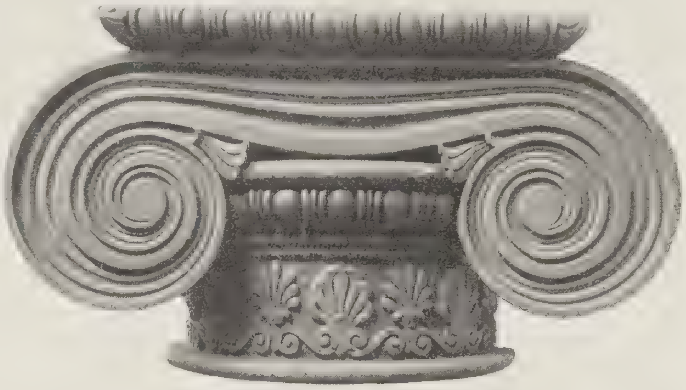
During the past month the prospectus of the preliminary competition for the New York Public Library has been published. As announced recently in THE BRICKBUILDER, this building is to be a large and important one, and will be the home of the Astor, Lenox, and Tilden Libraries. $2,500,000 has been appropriated. Unfortunately the conditions of the competition are so unsatisfactory that very few of the leading architects will compete. Just now the New York architects are making a bold stand to have competitions properly conducted. It is a noble and worthy effort, and cannot be too highly commended.

ST. JAMES BUILDING, 26TH STREET AND BROADWAY, NEW YORK CITY.
Bruce Price, Architect.
The four hundred thousand red face brick used in the four exterior walls of this building were made by the Fuller Brick and Slate Company, Pine Grove Furnace, Pa., and supplied through their New York representatives, H. F. Mayland & Co.

Barnard College has been presented with $140,000 by Mrs. Joseph M. Fiske, to be devoted to a dormitory building.

The designing of the new Hall of Records has been entrusted to J. R. Thomas, who received first prize in the late City Hall competition.

Preparations for the new Chamber of Commerce are being made rapidly. $300,000 has been subscribed towards the building fund. The building will cost about $1,000,000.



CAP TO COLUMN, ENTRANCE BOHEMIAN CLUB, NEW YORK CITY.
Made by Excelsior Terra-Cotta Company.

Plans have been filed for an addition to the American Museum. of Natural History, to cost $500,000. Cady, Berg & See are the architects.

Little & Brown, of Boston, have planned a $100,000 house for Mr. E. W. Bliss, to be built on 61st Street, East.

F. A. Minuth has plans for the new $80,000 church for St. Paul's Lutheran Association, 22d Street and Eighth Avenue.

Plans have been filed for seven four-story and basement brick and stone dwellings on Riverside drive and 80th Street. Cost, $180,000. Clarence True, architect.

William R. Grace has purchased four lots on the north side of 60th Street near Amsterdam Avenue, as a site for the Grace Institute, for the instruction of young women, in practical arts and business.

Renwick, Aspinwall & Owen have prepared plans for a $100,000 country residence for Mr. Frederick Potter, at Sing Sing on the Hudson. It will be 60 by 150 ft., built of brick and terra-cotta.

Plans have been filed for a fifteen-story office building, 9 to 13 Maiden Lane, for Mr. Frank Gill. R. S. Townsend, architect.

C. P. H. Gilbert has planned a $200,000 hotel for R. N. Rafalsky, on 45th Street near Sixth Avenue, to be used as bachelor apartments.

Babb, Cook & Willard have planned a printing office for the New York Life Insurance Company, to be built corner of Elm and Leonard Streets. Cost, $150,000.

An addition to St. Vincent's Hospital, West 11th Street, near

CAP TO PILASTER, FOURTEENTH STORY, ST. JAMES BUILDING, NEW YORK CITY.
Bruce Price, Architect.
Made by Perth Amboy Terra-Cotta Company.

TERRA-COTTA ARCH, FIFTEENTH STORY, ST. JAMES BUILDING, NEW YORK CITY.
Bruce Price, Architect.
Made by the Perth Amboy Terra-Cotta Company.

Greenwich Avenue, will be built at a cost of $300,000. Schickel & Ditmars, architects.

Mr. J. T. Tower has bought the property 50 by 100 ft. corner of Fifth Avenue and 45th Street, for $410,000. He intends to erect a ten-story office and studio building.

The Metropolitan Street Railway Company intend to erect a car and power house at 146th Street and Lenox Avenue, at a cost of $200,000. A. V. Porter, architect.

PHILADELPHIA. — There seems to be a steady improvement in the building trades, and we are told that there have been more projects figured upon within the last three months than in any similar time since the depression reached this city.

Prominent amongst the projects now being put forth we may mention the Parkside Apartment House, which will be built on the corner of Parkside Avenue, 40th Street and Girard Avenue, a location unexcelled for a building of its kind. It will be of light bricks, stone, and terra cotta, seven and a half stories high, and the three fronts will be 90 ft., 29 ft., and 75 ft. respectively. The style will be French Renaissance, the lobby and main entrance in the style of Louis XVI., and the reception room Moorish; there will be a restaurant on the top floor, and a roof garden above. Architect Angus S. Wade has the work in charge.

Architects D. H. Burnham & Co., of Chicago, Ill., have completed the drawings for the $2,000,000 office building which the Land Title & Trust Company of this city expect to erect at the corner of Broad and Chestnut Streets. The site has been cleared of the buildings which formerly occupied it, and estimates upon the work are being made. The building will be 75 by 100 ft., fifteen stories high, the first and second of granite, and the others of buff brick and terra-cotta. It is intended to be the best equipped and most thoroughly modern office building in the city.

An apartment house will also be erected at 16th and Spruce Streets, by Mr. A. H. Mershon, from plans made by architect Thomas Bennett. This will also be thoroughly up to date, and of brick and terra-cotta.

There will be an addition built to the infirmary at Girard College. It will be three stories and basement, and conform to the present building. It will be 75 by 154 ft., and contain mortuary room, disinfecting room, swimming pool, and large wards.

The first award of the John Stewardson memorial scholarship in architecture was made on Monday last to H. L. Duhring, Jr., a graduate of the School of Architecture of the University of Pennsylvania. The problem was a city church in the style of the Renaissance. Mr. Duhring's design was adjudged as of especial merit. Charles Z. Klauder and Oscar M. Hokanson were awarded equal honorable mentions. The first prize gives to Mr. Duhring the use of $1,000 to be expended in travel and study in Europe, under the direction of the trustees of the fund. The judges were Prof. Wm. R. Ware, of Columbia College, G. L. Heins, and John Galen Howard, all prominent architects of New York.

BUFFALO. — Activity in the architectural and building lines in general is becoming now a little more pronounced. One noticeable feature is that few good buildings of the residence class are in progress, but chiefly flats and tenement buildings of low cost, which tends to prove that business has not improved to the extent anticipated.

Amongst the more prominent buildings nearing completion may be mentioned the eight-story apartment house, "The Lenox," on North Street near Delaware Avenue. Lovering & Whalen, architects.

The entire cost of the building was about $400,000.

The John Otto & Son's five-story, fire-proof store and office building on Main Street. This building, with a frontage of 110 ft., has a first story of granite, and the entire superstructure of light buff terra-cotta, manufactured by the Northwestern Terra-Cotta Company, of Chicago; the four-story business block on Main Street, near Huron Street, erected by the Evans Estate; this building is of steel construction, fire-proof, and has a very ornate front composed entirely of white terra-cotta, supplied by the above-named firm. E. A. Kent is the architect for both these buildings.

Amongst projected buildings may be mentioned the $50,000 "Welcome Hall," to be erected on Seneca Street by the First Presbyterian Church, and to be used as a place of recreation and reformation of the lower classes of all creeds. Green & Wicks are the architects.

The same firm is preparing drawings for the new ten-story, fire-proof office building to be erected by the trustees of Syracuse University, at Syracuse, at an expenditure of $451,000; also the new brick residence and stable,

TERRA-COTTA DETAIL, OFFICE BUILDING, FIFTH AVENUE, NEW YORK.
Albert Wagner, Architect.
Made by White Brick and Terra-Cotta Company.

THIRD STORY WINDOW, VAN RENSSELAER HOUSES, ALBANY, N. Y.
Marcus T. Reynolds, Architect.
Made by New York Architectural Terra-Cotta Company.

MAIN CORNICE, VAN RENSSELAER HOUSES, ALBANY, N. Y.
Marcus T. Reynolds, Architect.
Made by the New York Architectural Terra-Cotta Company.

designed in a most severe style of Elizabethan architecture, at the corner of Delaware Avenue and Ferry Street, for John Glenny.

The Historical Society has finally decided to erect their new building in the Delaware Park, near the lake, at an outlay of $50,000, but as yet no architect has been selected; in fact, it has not been decided whether or not it will be put up to open competition.

The erection of an enormous convention hall by this city has been authorized by both houses, and the sum of $400,000 appropriated, but no site has yet been selected, although the idea of using the present Chippewa Market site, and having the hall built over the market, is meeting with much favor. When the ideas of the public are finally crystallized, competitive designs are to be asked for.

The contract for the new shops of the Merchants' Dispatch Company at Penfield, N. Y., has been let to J. L. Stewart & Co., for $118,215.

The new East Side High School, also four new public schools, are almost ready for use, and are to be formally opened after the summer recess. Two of the schools have been built of fire-proof construction, and since it has been found that the cost did not exceed that of the non-fire-proof ones, the intention is that all new buildings used for school purposes shall be built as nearly fire-proof as possible.

SECOND STORY WINDOW, VAN RENSSELAER HOUSES, ALBANY, N. Y.
Marcus T. Reynolds, Architect.
Made by the New York Architectural Terra-Cotta Company.

PITTSBURG. Building projects are on the increase, and several very good buildings are under way, among them being the new Horne Store Building, to be erected on the site of the burnt building, from plans by architects Peabody & Stearns, to be steel and fire-proof construction. The Horne Office Building, which was also destroyed by the fire, will be rebuilt from plans by architects Struthers & Hannah, successors of the late W. S. Fraser. The same firm are also preparing plans for a five-story building for Mrs. McCullough, to be erected opposite this building, but facing on Liberty Street, to be of brick and terra-cotta. The Jenkins Building, in which the fire originated, will be rebuilt from plans prepared by architects Topp & Craig. It is to be six stories, and of steel construction, to cost $150,000. The same firm are preparing plans for a brick hotel, to be erected at Ebensburg, Penn., for G. B. Denny, Esq. Architects Alden & Harlow are preparing plans for the West End branch of the Carnegie Library. Architects Geo. Orth & Bros. are preparing plans for a large brick warehouse for Harry Darlington, to be erected on Seventh Avenue. The B. P. O. E. of Allegheny

are contemplating the erection of a club house, to cost $25,000. Architect S. T. McClarren has prepared plans for a sixteen-room schoolhouse for the sixteenth ward, to cost about $75,000. Architect J. E. Campbell has prepared plans for a six-story hotel building at Greensburg, Penn., for Jno. Keck, Esq., to cost $40,000. City architect H. S. Bair is preparing plans for No. 27 Engine House, to be two stories, brick and stone.

The "Colonial," which is designed for bachelor apartments, has just been completed. Messrs. Barnett, Haynes & Barnett were the architects. The building occupies the site of the old J. E. Kaime residence, and into which the old residence has been incorporated.

PROPOSED BUILDING FOR THE CURTIS PUBLISHING COMPANY, SIXTH AND WALNUT STREETS, PHILADELPHIA, PA.
MacCollin & Fast, Architects.

ST. LOUIS.— There is less work in the architects' offices at the present time than at any previous time within a number of years, not excepting during the panic of 1893. The report of the Commissioner of Buildings shows permits taken out for improvements aggregate more than for the corresponding time last year, but it consists mostly of alteration and small residences or cheap flats, which are innocent of ever having been in an architect's office.

Architect August Brinke has prepared plans for an apartment building 150 by 215 ft., to cost $125,000, and for a bakery to be located on Grand Avenue, to cost $200,000, for the Weile, Boettlers Bakery Company.

Architect H. E. Roach has prepared plans for an apartment building for Mr. E. B. Woolfe, to cost $500,000.

TERRA-COTTA DETAIL, HORTICULTURAL HALL, PHILADELPHIA.
Frank Miles Day & Brother, Architects.
Made by the Conkling-Armstrong Terra-Cotta Company.

DETROIT. — Architect Gustav A. Mueller has completed plans and let the contracts for the erection of a handsome five-story store for Ernst Kern, retail dry goods dealer, to be erected at the southeast corner of Woodward and Gratiot Avenues. It will have a frontage of 36 ft. 8 ins. on the former avenue, and 100 ft. on the latter. The exterior will be of buff pressed brick, with trimmings of Ohio buff sandstone and terra-cotta. It will cost $35,000.

Architects Malcomson & Higginbotham are preparing plans for a $30,000 residence for Edward Ford, Wyandotte, Mich., to be of pressed brick, terra-cotta, and buff sandstone. Also completed plans for additions to two public school buildings for the Board of Education, Detroit, to be of brick, and cost respectively $20,000 and $10,000. Also completed plans for a two-story pressed brick residence for Dr. Reuben H. Osborne, to be built on Ledyard Street, to cost $10,000.

Architects Spier & Rohns have prepared plans for a two and a half story pressed brick and stone residence for C. W. Althouse, to

be built at the northwest corner of Woodward and Delaware Avenues. It will have tile roof, and cost $20,000. Also prepared plans for a two-story pressed brick parochial residence for the Roman Catholic parish of the Sacred Heart of St. Mary, to cost $10,000.

Architects John Scott & Co. have completed plans and awarded contracts for a three-story double residence for Jeremiah Dwyer, to be built at the northwest corner of Jefferson and St. Aubint Avenues. It will be of buff pressed brick trimmed with terra-cotta and buff sandstone, and cost $17,000.

Architect Edward C. Van Leyen has prepared plans for a two and a half story pressed brick residence for Charles L. Coffin, to be built on Medbury Avenue. It will have tile roof, and cost $10,000.

Architects Mortimer L. Smith & Son have completed plans for a $10,000 pressed brick double residence for Mrs. O. N. Brown, to be built on Warren Avenue.

Architects Baxter & Hill have plans for a two and a half story

TERRA-COTTA DETAIL, BRAZIER BUILDING, BOSTON.
Cass Gilbert, Architect.
Made by the Northwestern Terra-Cotta Company.

stone and pressed brick residence for Edwin Earle, to be built on the east side of Woodward Avenue, to cost $10,000.

Architect Albert E. French has prepared plans for a two and a half story pressed brick residence with cut stone trimmings for Justice H. L. Shellenburg, to be built on Forest Avenue, at a cost of $10,000.

PERSONAL AND CLUB NEWS.

Mr. L. D. Bayley has retired from the firm of Putnam & Bayley, architects, Northampton, Mass., and has formed a copartnership with Mr. Goodrich, of Hartford, Conn., under the firm name of Bayley & Goodrich. Mr. Putnam will continue the business of the old firm.

The Chicago Architectural Club held its last "Bohemian night" meeting before vacation, on Monday evening, June 7, in the club rooms. H. Y. von Holst, Adolph F. Bernhard, Chas. Eliot Birge were hosts. The club rooms will be open during vacation.

The regular monthly meeting of the St. Louis Architectural Club was held on Saturday evening, June 5. It was decided to discontinue the classes during the summer months excepting the watercolor class, under the instructions of F. C. Dwyer.

The club's exhibition, which is purely local, consisting solely of the work of members of the club, opened on the same evening.

The monthly meetings, which are largely of a social character, will be in the way of excursions, etc., until the fall work commences. The first of these excursions will be to Belleville, Ill., to inspect the brickyards at that place.

ITEMS OF INTEREST AND VALUE.

The city of Worcester has contracted for Atlas brand American Portland cement for this season's supply.

Powhatan cream-white bricks will be used in the new Troy Bazaar Building, at Troy, N. Y.

Waldo Brothers have secured the cement contract for the city of Quincy, Mass., for this year, supplying them Hoffman, Rosendale, and Atlas brand of American Portland.

H. F. Mayland & Co. are the New York representatives of The Burlington Architectural Terra-Cotta Company, of Burlington, N. J.

The town of Melrose, Mass., has contracted with Waldo Brothers for their season's supply of cement, the brands being Hoffman, Rosendale, and Brooks, Shoobridge & Co. Portland.

The cement for the Southern Union Station has been awarded to Waldo Brothers by Norcross Brothers, Hoffman being the brand. This is the largest order for cement ever placed in Boston.

H. F. Mayland & Co., United Charities Building, are the New York representatives for Messrs. Oliphant & Pope, manufacturers of white and mottled front brick from plastic clay.

The Powhatan cream bricks which are being used for the front walls of the new Art Museum, Worcester, Mass., are supplied by Waldo Brothers.

The town of Milton, Mass., has contracted with Waldo Brothers for the furnishing of Brooks, Shoobridge & Co. Portland and Hoffman Rosendale cement for this year.

The contract for Portland cement to be used by the town of Wellesley, Mass., has been awarded to Brooks, Shoobridge & Co., Waldo Brothers being agents.

The American Enameled Brick and Tile Company have just closed a good-sized order with Messrs. Norcross Brothers for enameled brick for private stable of Mr. William K. Vanderbilt, at Hyde Park, N. Y.

The Philadelphia and Boston Face Brick Company have closed the following contracts: buff molded and arch brick for B. & M. Railroad Company station at Northampton, Mass.; gray molded brick for Pierce Building on Vernon Street, Boston; buff face and molded brick for Mayo Building, at Erie, Penn.

Charles T. Harris, Lessee, Celadon Terra-Cotta Company, will supply the roofing tiles for the following buildings: Mortuary

Chapel, Wildwood Cemetery, Williamsport, Penn., D. K. Dean, architect; station for Erie Railroad, at Jamestown, N. Y., G. E. Archer, architect; station for the Erie Railroad, at Paterson, N. J., G. E. Archer, architect; residence for C. W. Hoff, Chicago.

FISKE, HOMES & Co. have just completed two large orders for brick at Providence, — the State Normal School, Martin & Hall, architects, and the new railroad station, Stone, Carpenter & Wilson, architects; the former a light buff, and the latter a fire-flashed mottled brick. They are now supplying the Falston brick for the new Masonic Temple at Pawtucket. W. R. Walker & Son, architects.

AN interesting piece of work is now being done for the new bath house at Revere Beach, Mass., by W. T. Eaton, in connection with the Murdock Parlor Grate Company. It consists of a sea wall and a considerable quantity of artificial stone work, both being made of Alsen German Portland cement and furnished by Waldo Brothers. We predict a large amount of this work will be done in the near future with Portland cement.

MEEKER, CARTER, BOORAEM & Co., New York City, have taken the agency of the Eastern Paving Brick Company, of Catskill, N. Y., and have in charge the paving of the streets of Patchogue, L. I. Mr. Paul O'Brien will have charge of this department. This company under its new management is making a high-class vitrified shale paving brick at the rate of 100,000 per day, and their water facilities and nearness to the Metropolitan district gives them a decided advantage in that market.

H. H. MEIERS & Co.'s Puzzolan German Portland cement has been specified by Winslow & Wetherell, architects, for the White Building, on Boylston Street, the Converse Building, on Milk Street, and also for the office building on the corner of Kilby and Doane Streets, Boston. The cement is called for on account of its non-staining qualities as well as its high tensile strength, and all the brickwork in connection with the front will be laid with this cement. Waldo Brothers, Boston agents, will furnish it.

THE BOLLES SLIDING AND REVOLVING SASH has been specified for a large apartment house in Atlanta, a block of houses in Indianapolis, and for the new Court House for McDonough County, Georgia. Agencies have been established as follows: V. H. Kriegshaber, Atlanta, Ga.; F. Codman Ford, New Orleans, La.; A. L. Blair, Richmond, Va.; Harding & Whiteside, Louisville, Ky.; Wm. B. Roberts, Indianapolis, Ind.; Cyrus P. Finley, St. Louis, Mo.; George W. Laws & Co., St. Paul and Minneapolis, Minn.

A USEFUL and very interesting book is "A Mint of Hints," just issued by the American Clay-Working Machinery Company, of Bucyrus, Ohio. The book is one of the prettiest ever sent out to brick and tile makers, is printed in brown and green ink, and is enclosed in a handsomely embossed cover. In this work is given a description of the Durant hollow building block, and matter showing its superiority as a building material. There is also shown a multitude of shapes and forms of all kinds of brick.

THE GLOBE FIRE-PROOFING COMPANY, of Philadelphia, have started their new and modern plant for the manufacture of fire-proofing and brick, at Clayville, N. J. They are in the market with a beautiful line of tempered clay buff brick, and are manufacturing all kinds of flat and segmental arches, furring, partition, roof and ceiling blocks, girder and column covering. All these materials burn a beautiful buff, and are made of fire-clay. The main office is at 449 Philadelphia Bourse; Boston office, 443 Tremont Building; New York office, 412 Presbyterian Building, 156 Fifth Avenue.

THE copartnership heretofore existing between George R. Twichell and Alfred Yates, dealers in builders' supplies at 19 Federal Street, Boston, under the name and style of G. R. Twichell & Co., has been dissolved by mutual consent. The business in future will be carried on at the same location by George R. Twichell, under the same name and style, who will assume all liabilities, and receive all accounts payable to said late firm.

CHAMBERS BROTHERS COMPANY, of Philadelphia, have recently erected and started a plant for making hollow brick, on the yard of the C. P. Merwin Brick Company, at Berlin, Conn.

Their exhibit of brick-making machinery at the Tennessee Centennial, at Nashville, Tenn., where they have erected a building for their own use, and installed about $20,000 worth of machinery, is in operation and receiving a great deal of attention. This is one of the few machinery exhibits which was ready to go on the opening day. One characteristic feature of the Chambers machines is that when the engine starts the Chambers machine makes brick.

COLUMBUS BRICK AND TERRA-COTTA COMPANY, Columbus, Ohio, have recently secured the contracts to furnish the bricks on the following jobs: Spahr Building, Columbus, Ohio, D. H. Burnham & Co., architects; terra-cotta Roman brick to be used. High school at Urbana, Ohio, Yost & Packard, of Columbus, architects; light-gray standard brick. Townshend Hall, Ohio State University at Columbus, Peters, Burns & Pretzinger, architects; dark-gray standard bricks. Toledo High School, Toledo, Ohio, Bacon & Huber, architects; first story, dark-gray bricks; second story, buff. Henry Flesh residence at Piqua, Peters, Burns & Pretzinger, architects; gray Roman bricks. Residence, Geo. H. Partridge, Minneapolis, Minn., Long & Rees, architects; dark-buff Roman. Residence of Carl Hoster at Columbus, A. A. Linthwaite, architects; gray standard brick.

THE BURLINGTON ARCHITECTURAL TERRA-COTTA COMPANY have contracted for the following work: twelve houses, Broad Street and Erie Avenue, Philadelphia, H. E. Flower, architect; addition to the Hayes Mechanics' Home, Philadelphia, Kean & Mead, architects; new office building for the Prospect Brewing Company, Philadelphia, A. C. Wagner, architect.

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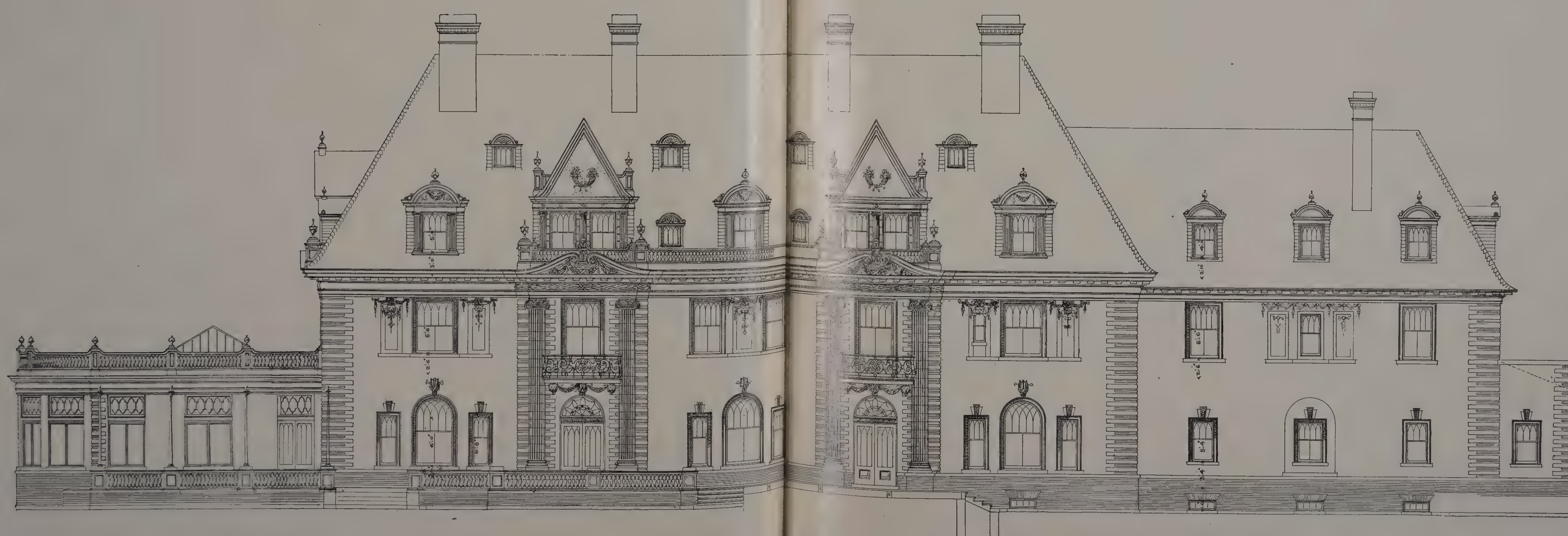
RESIDENCE FOR GEORGE

BRUCE

VOL. 6. NO. 6 PLATES 49 and 50.

North Elevation.

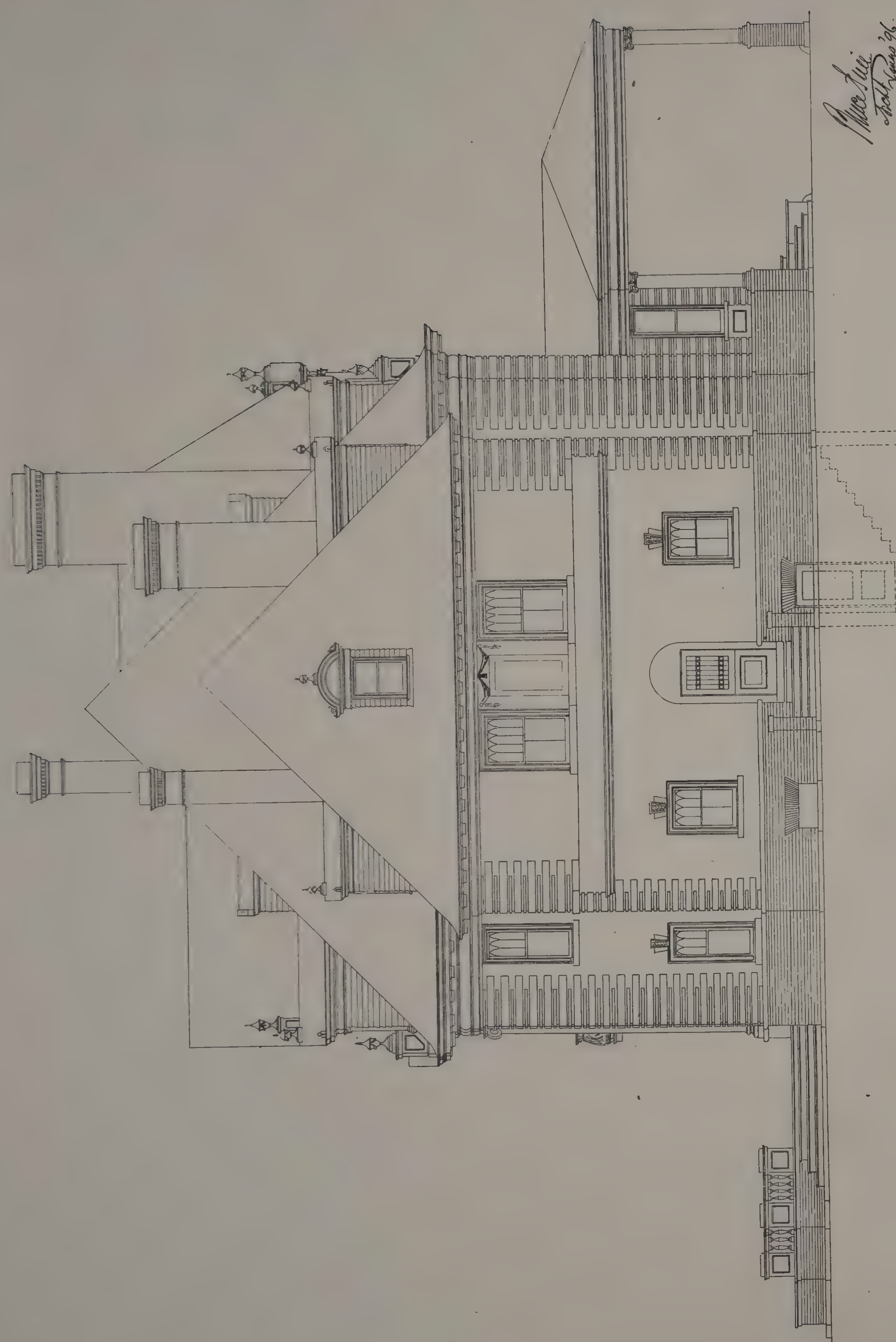


South Elevation.

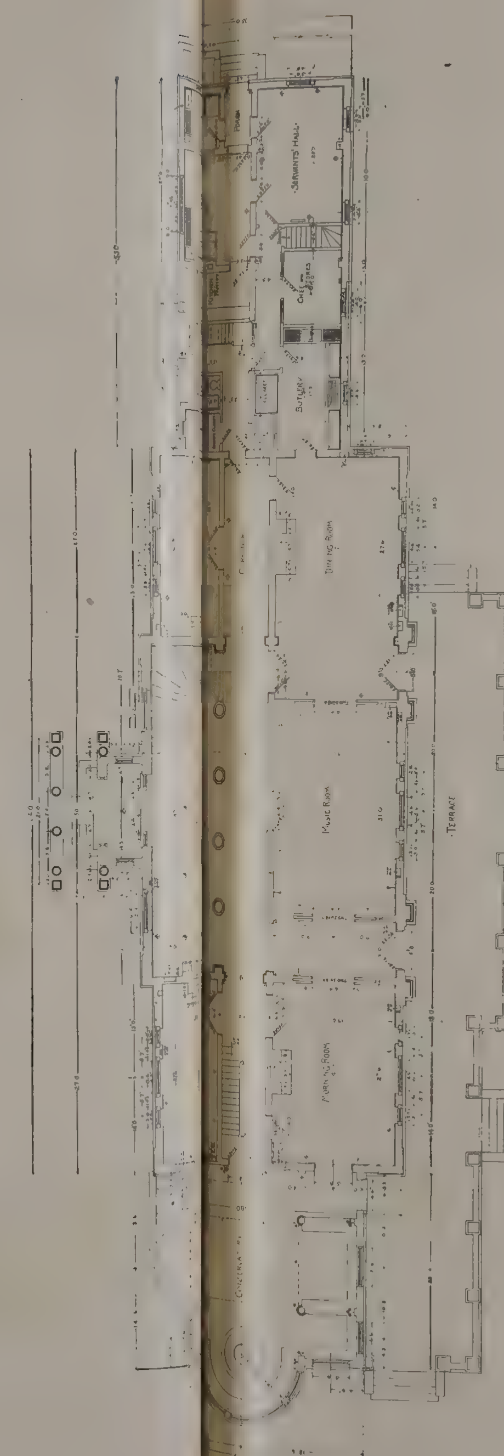
RESIDENCE FOR GEORGE J. GOULD, Esq., LAKEWOOD, N. J.

BRUCE PRICE, Architect.

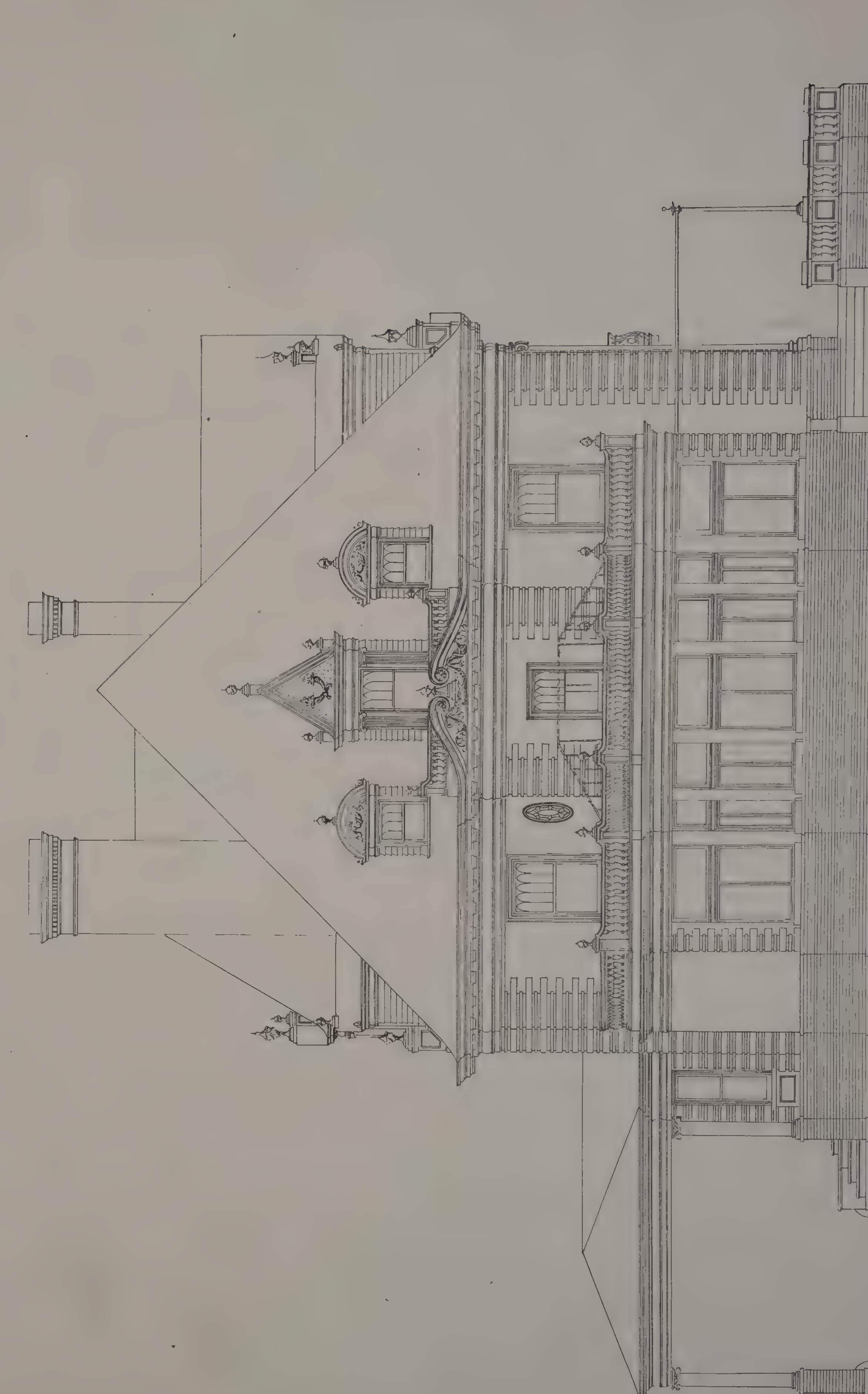
East Elevation.



East Elevation.



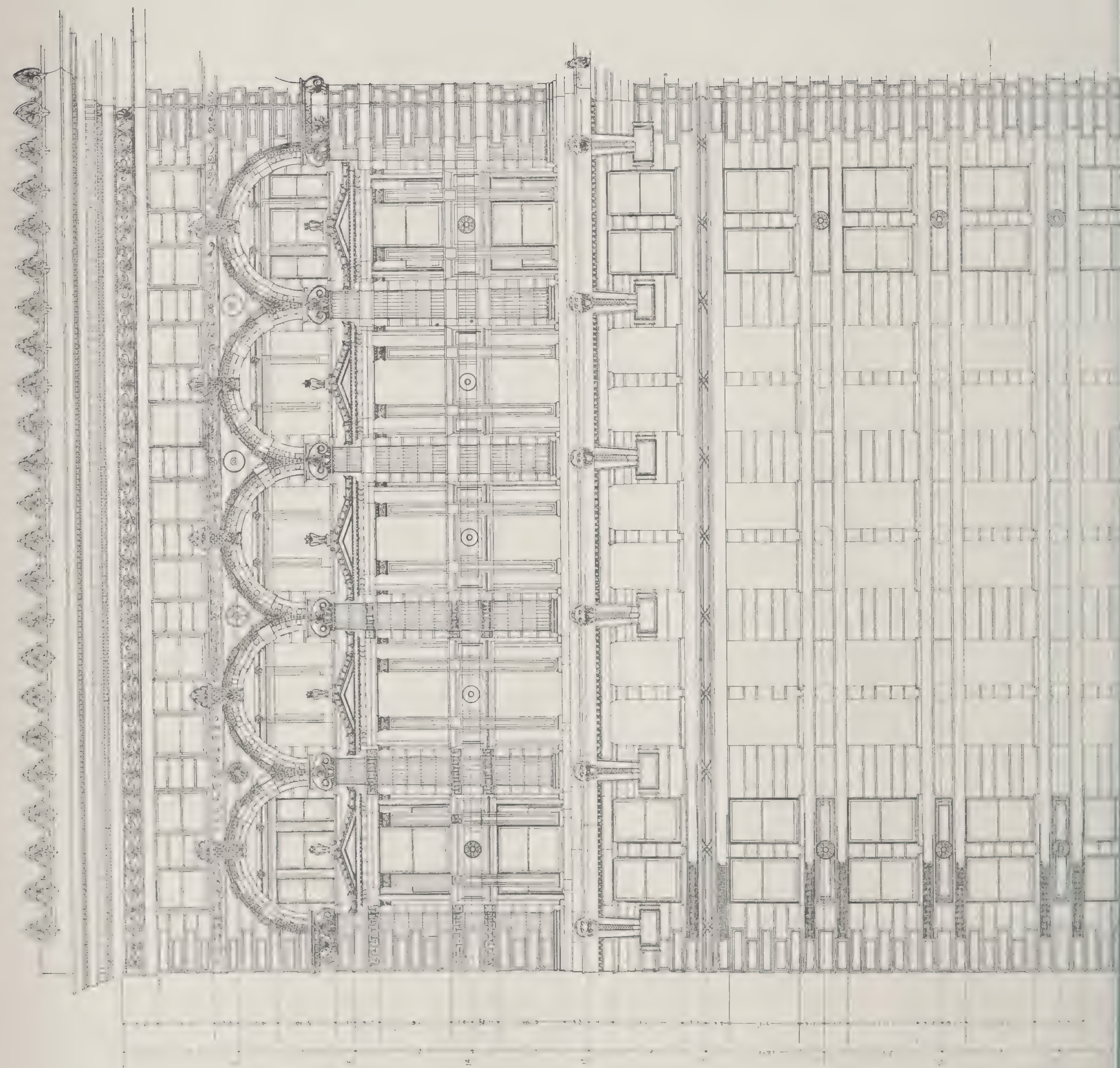
First Floor Plan.

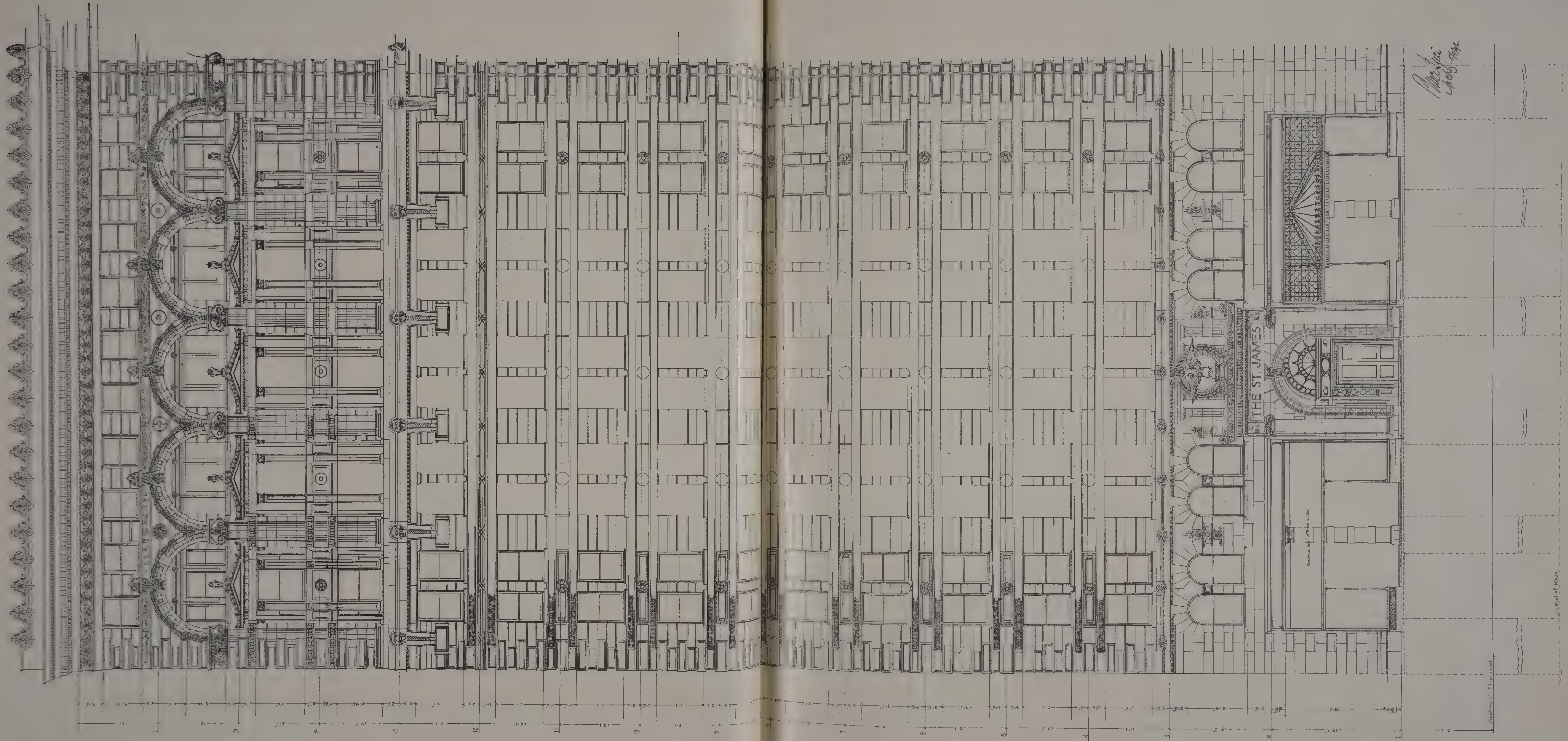


West Elevation.

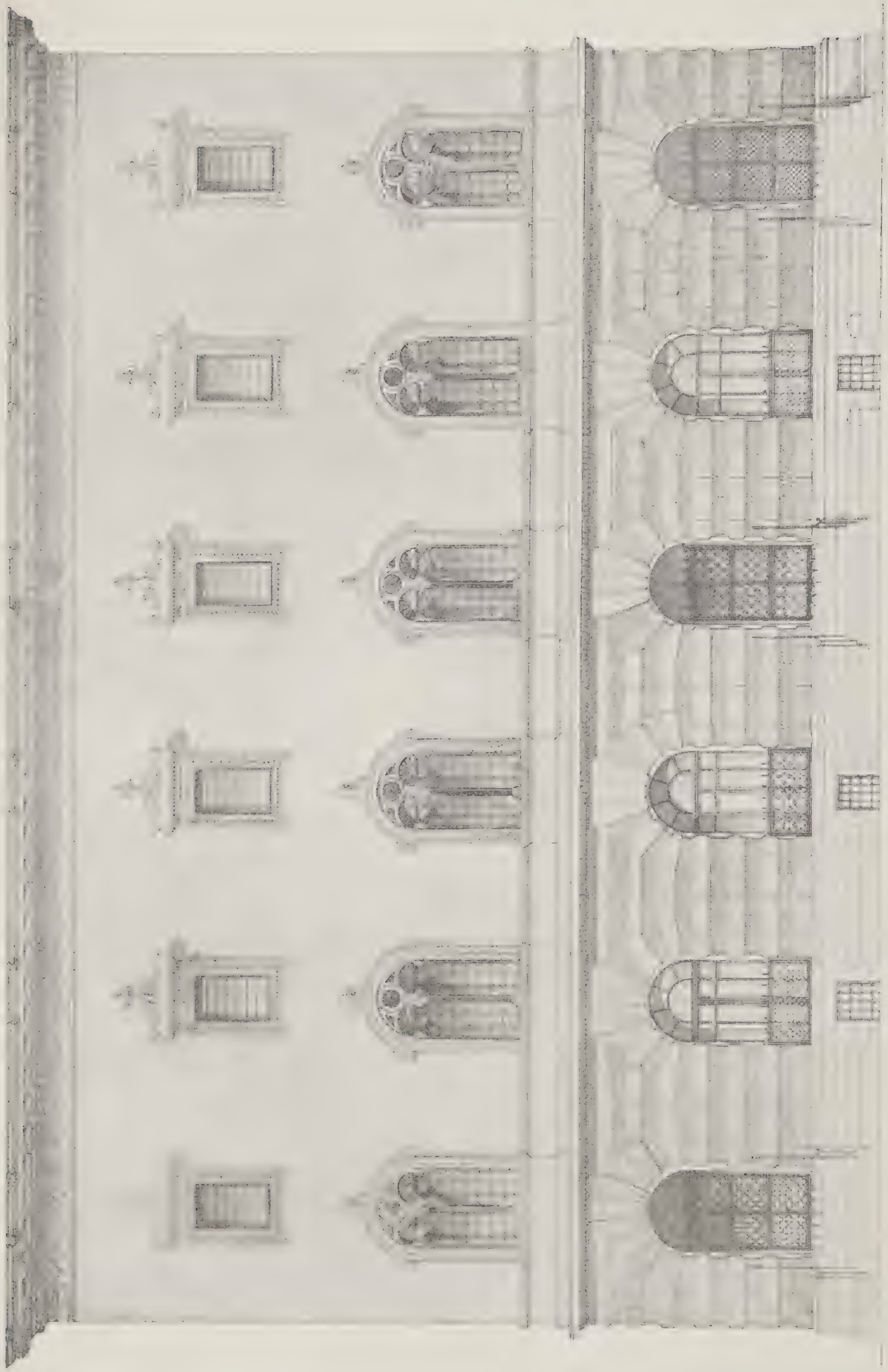
RESIDENCE FOR GEORGE J. GOULD, Esq., LAKEWOOD, N. J.

BRUCE PRICE, Architect.



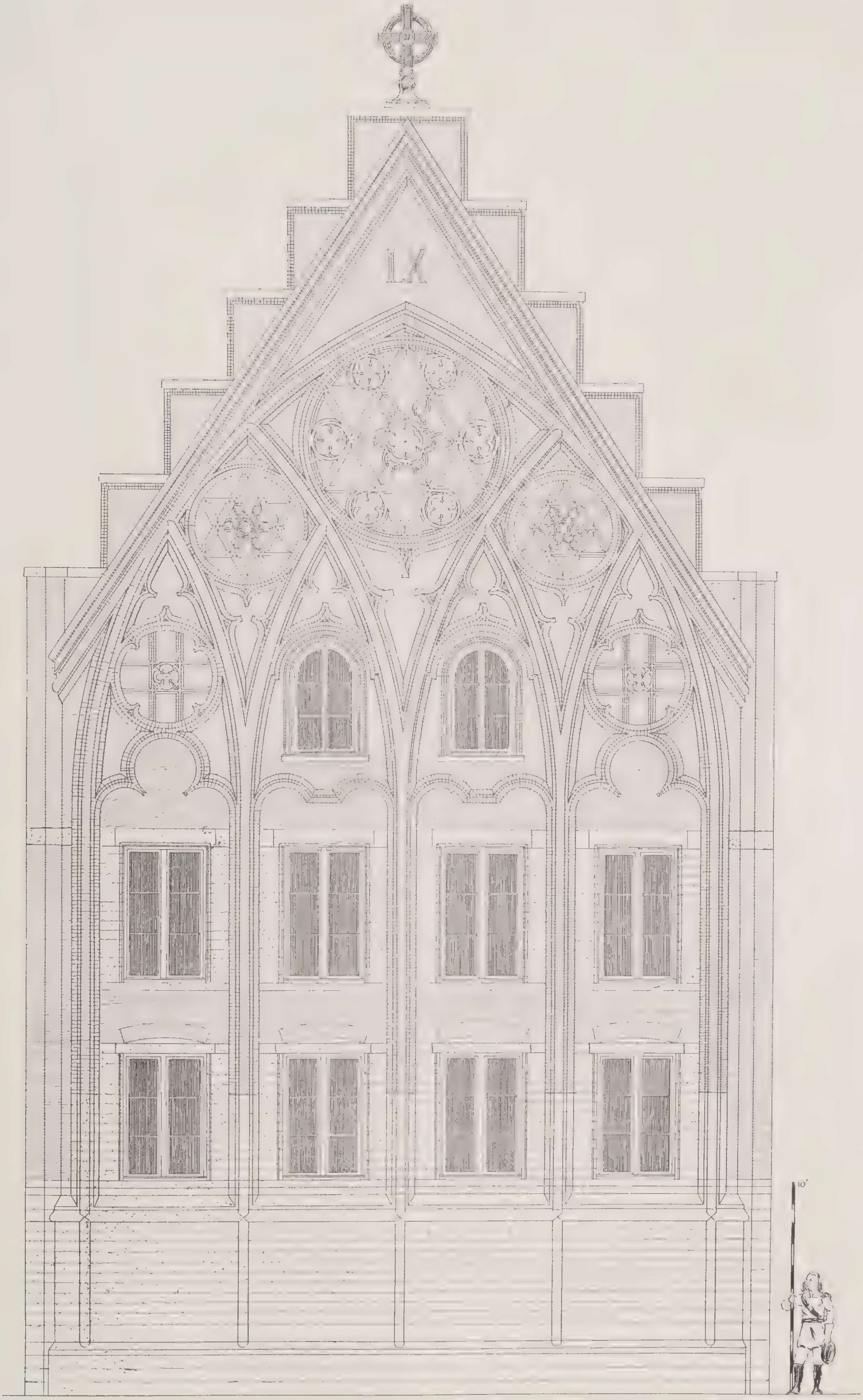


ST. JAMES OFFICE BUILDING, 26TH STREET AND BROADWAY, NEW YORK.
BRUCE PRICE, ARCHITECT.



THREE RESIDENCES IN TERRA-COTTA FOR THE MESSRS. VAN RENSSELAER, ALBANY, N. Y.

MARCUS T. REYNOLDS, Architect



ATHÉNÉE ROYAL, ÉCOLE LIBÉRALE, LOUVAIN, BELGIUM.

From Sketches by J. K. CADY.

VOLVME VI JULY 1897 No. 7

THE BRICKBVILDER

OFFICE 85 WATER STREET BOSTON

THE BRICKBUILDER.

AN ILLUSTRATED MONTHLY DEVOTED TO THE ADVANCEMENT OF ARCHITECTURE IN MATERIALS OF CLAY.

PUBLISHED BY

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SOME LESSONS OF THE PITTSBURGH FIRE.

THE great value of the fire that occurred in Pittsburgh on the 3d of May as an object lesson to all who are interested in the reduction of fire losses in buildings has been attested by the extended notices and discussions that have appeared in the architectural and technical journals. Some of the technical journals sent special representatives to investigate it, who gave more or less correct accounts, according to the authorities they consulted. THE BRICKBUILDER was the only journal that sent an acknowledged expert in fire-proof construction to make an unprejudiced report on it, which appeared, fully illustrated, in the June number. It was the only report that correctly described and illustrated the several methods of construction used in the buildings. It was demonstrated that the two buildings most severely tested were fire-proofed with systems depending on the use of burned clay, and the material of each differed from that of the other. It was shown that the integrity of each building was assured by its fire-proof interior construction, and that the only parts carried down in one of them, involving a large and easily preventable loss, were destroyed through ignorance or carelessness in locating and supporting a huge water tank, and not through any failure of the fire-proofing system employed. Had this not occurred, there is no doubt but that all of the brick walls, and the steel work of the floors, roofs, ceilings, girders, and columns of both buildings would have been preserved. The value of fire-proofing with burned clay was demonstrated to the extent that while it might not in every case save itself, it can preserve from loss that which it is put to preserve.

This fire seems to have brought to the attention of underwriters, what is no surprise to any intelligent architect, the fact that if a building does not collapse the fire has a freer way through the goods contained in it. It is only a question of rates on goods with them, and does not concern us. If a building is undivided by partitions, they must necessarily put a higher rate on the goods; but the greatest demonstration has been made in the Jas. Horne Department Store, that, even though undivided by partitions, the building itself can stand the fire. They ought to be convinced of a matter in which some of them have doubts that fire-proof buildings, well constructed, can take care of themselves under all contingencies, and they now have some data for estimating what the greatest percentage of loss on such buildings can be. The Horne Office Building is one which best demonstrates the risk in the average of modern fire-proof building, and it had two dangerous elements, the exterior exposure and the open light court.

The first lesson to architects and owners, no less than to underwriters, is, that if you put a closed tank, in the form of a steel boiler, on the top of a building, even though it be placed there to furnish a supply of water to extinguish incipient fires, you are handling a very dangerous thing. The most improved systems for operating water elevators make it unnecessary to put a closed tank on the top of a building. Tanks in such places are necessary only where the automatic sprinkling system is used, and they can always be open tanks, built of wood, and supported so that they will tip over in case of fire and then do some good. There is no necessity for large tanks for ordinary water service, where pumps may be used constantly, or with automatic attachments. Another valuable precaution in fire-proof buildings, which has been used in some, would be to place a strong grill of steel over every elevator, sufficient to arrest the fall of the shieves and their supporting beams — which have to be exposed.

THE value of subdividing buildings by partitions needs no demonstration; but this can be done according to a system, and should be part of the original plan of the building. With a slight variation from what is considered the most convenient plan, any building can be provided with effective vertical fire barriers, and often buildings can be divided into sections without impairing the convenience of their plans. Forty years ago the printing house of Harper & Brothers, in New York, was built without an interior stairway or elevator, these being placed in towers in a court. There are two modern fire-proof buildings in this country which are built on a fire-proof plan. They are those of the American Bank Note Engraving Company, at New York, and Gore's Fire-proof Hotel, in Chicago. Both are built with a long court in the center, and with stairways and elevators so separated, being placed at both ends of the court, that they do not need fire escapes. In these buildings one half is the fire escape for the other half.

With regard to the details of fire-proofing with burned clay, we always have many things to learn as well as many reasons for congratulation in the present instance. Clay fire-proofing has to perform two offices; one is construction or work, and the other is protection. Protection is also sometimes combined with construction. Floors, ceilings, and roofs are constructions. It has been demonstrated that a flat, hollow arch, two cells deep, will support a floor and stop fire even when the bottom cell is broken. It has also been demonstrated that a beam covered by a one-cell hollow block will be protected

when the outside shell of that block falls off. It has been shown that a semi-porous tile, when used for a continuous flat arch ceiling, will not be flaked off on the bottom, but that it may if used around a beam, two sides being exposed. It has been shown that in hard, hollow blocks of many cells the exterior shell is likely to be broken under any circumstances. The advantage is with the semi-porous tile, but the disadvantage is with the shape required for the projection of beams. The whole demonstration is that the continuous ceiling is the safest, especially when semi-porous tiles are used. There are some kinds of porous terra-cotta that will stand any fire-and-water test; but there is a difference whether the material is hollow or solid. In many cases it is best to use it solid, depending on the non-conduction of the material itself.

THE covering of the heavy steel built-up girders of the Horne Department Store was effective, and yet it was not by any means put on in a workmanlike manner. Large flat tiles of hard fire-clay were cramped to the bottoms of the girder, with steel cramps, and the sides were covered by 4 in. partition blocks resting on the flange. Great risk was taken in leaving the cramps exposed. They must have been raised to a white heat, and could not have sustained much weight; but it seems that each was able to keep its tile in place, the weight being, probably, not more than 4 lbs. to each cramp. The best methods for covering girders heretofore used have been with U shaped blocks of porous terra-cotta, extending far enough below the girder to support a soffit tile. Such blocks are firmly held in place by the mortar with which they are filled in setting, and partition tiles built on them to cover the sides of the girders add to their stability.

There are, unfortunately, too many Z bar columns in other buildings covered as were those in the Horne Department Store. It cannot be said that these columns were fire-proofed at all; 2 in. hollow partitions were simply built around them, and left to themselves. This would have been a compliance with the building laws of any city that compels all columns to be covered with "fire-proof material," providing for "two air spaces of at least 1 in."; and it demonstrates how defective such laws are. The contingencies that surround iron columns in any building are many, and have been the subject of experiments and inventions of experts for twenty years; but there is surely one principle that should be observed in fire-proofing columns, and that is that the material should be *fastened to the steel column.*

The 4 in. semi-porous hollow partition tiles used in the Horne Office Building were effective wherever they were set, so that they could stand alone, but most of them were cracked because they were *built on wooden strips.* The tiles did not crack in the walls, and were only broken by their fall. In Plate 10, in the June BRICKBUILDER, is seen the result of using a wooden framework when the door is combined with hall partition sashwood. This could be avoided by using channel bar steel frames in such cases. These might be warpled somewhat, but would keep the partitions in place.

These criticisms are offered in good part, with the hope that they may be of some benefit to those concerned in the fire-proofing of buildings with burned clay. They show that the buildings in question are not the best that have been done. We have seen that buildings as a whole can be saved by fire-proofing; but the fire-proofer cannot only protect constructions of steel, but preserve his own work, if he studies and profits by experience. It is his interest to demonstrate that the saving from the loss by fire shall commence with his own materials and workmanship, and unquestionably this is possible with burned clay properly used. He has nothing to do with what comes after him, and is not expected to insure the goods placed in a building. He cannot always do as he wants to, and the architect may ask him to put his work where he knows it will not stay; but our architects can also profit by experience, and will not fail to heed the lessons of the hour. The model for a *fire-proof building* should be, as Mr. Reed says, a good stove that can be used many times, and not requiring a new lining every time that it is fired up.

THE report of S. Albert Reed, Ph. D., Manager of the Tariff Association of New York, on the Pittsburgh fire, published in *Engineering Record*, is a very interesting and truthful statement, full of valuable suggestions to underwriters that will doubtless be heeded. We may therefore expect to see in the near future such an adjustment of rates as will tend to exert a corrective influence upon some of the neglected details of fire-proof buildings. We are glad to see that Mr. Reed agrees with our expert in nearly every particular. He differs, however, in his theory of the direct cause of the falling of the water tank in the Horne Department Store. He gives great stress to the fact that the roof beams supporting the ⊥ irons and book tiles were not fire-proofed, and that the upper ends of the Z bar columns of the sixth story passing through the blind attic were not covered with tile. This was undoubtedly a case of neglect, yet the blind attic was cut off by tile bulkheads around the skylight. He thinks that these fell out, and that the weakness of the roof let down the tank, the roof falling first. This supposes that the tank rested on the roof, which no ordinary constructor would allow. As the roof did not fall around the light shaft where the tile bulkhead fell out, it must be presumed that the bulkheads of the elevators and light shaft were dislodged by the shock of the tank falling through the roof. The suspended ceiling proved to be sufficient to stop the fire everywhere else and saved three fifths of the roof. Hence it would have been a barrier to protect all the uncovered steel under the roof if the tank had not fallen. It was undoubtedly the fire that rushed out over the elevators and stairway that weakened the supports of the tank, whatever they were.

Mr. Reed has a higher opinion of the column and girder covering used than Mr. Wight. The following sentences from his report show its drift:—

"The skeleton as it stands is not out of line or plumb. Except for the fatal omission of protection to roof supports the skeleton protection of this building was an unusually good piece of work, and it did its task successfully and well, mainly because it was good and thorough. It is important to state that such good column and girder protection is the exception in the Metropolitan District of New York."

"The question of skeleton protection I consider as settled by this fire. With good protection the skeleton may absolutely be relied upon to stand even a conflagration."

ILLUSTRATED ADVERTISEMENTS.

IN the advertisement of Fiske, Homes & Co., page vii, is illustrated a new design for a fireplace mantel by J. A. Schweinfurth, architect. This company has recently had prepared, by several well-known architects, a series of designs for fireplace mantels in brick and terra-cotta, that are of unusual merit in the matter of design and construction, and it is their purpose to show a different style in each issue of THE BRICKBUILDER.

In the advertisement of R. Guastavino, page xvi, is shown a view of the test recently conducted under the supervision of the Engineering Department, city of Boston, of a section of Guastavino floor in the new building at 270 Congress Street, Boston.

The terra-cotta entrance to the Union Trust Building, St. Louis, Louis H. Sullivan, architect, is shown in the advertisement of the Winkle Terra-Cotta Company, page xi.

A very decorative terra-cotta capital, designed by Hoppin & Kohen, architects, is illustrated in the advertisement of the New Jersey Terra-Cotta Company, page viii.

In the advertisement of the Bolles Sliding and Revolving Sash Company, page xl, is illustrated the new American Baptist Publishing Building at Philadelphia, Penn., Hales & Ballinger, architects.

The new public school building at Dobbs Ferry, New York, C. Powell Karr, architect, is illustrated in the advertisement of Charles T. Harris, Lessee, Celadon Terra-Cotta Company, page xxviii.

A residence in brick and terra-cotta, by Green & Wicks,

architects, is published in connection with the advertisement of the Harbison & Walker Company on page xxx.

On page 160 the Philadelphia & Boston Face Brick Company

TERRA-COTTA PANEL.
Executed by the New York Architectural Terra-Cotta Company.

illustrate another of their series of handsomely designed brick mantels.

WE have received the "National Electrical Code," printed by the National Board of Fire Underwriters, the preparation of which is the result of the united efforts of the various electrical, insurance, architectural, and allied interests which have, through a national conference composed of delegates from nine of the leading architectural, engineering, and insurance societies, presented these rules for adoption by the various governing boards throughout the country. The effort to systematize and regulate the constantly changing practise in regard to electrical wiring is highly commendable, and the results embodied in this code represent the state of the science at the present time. Probably no branch of building industry has expanded so extensively within the last few years as has electrical science, and the rapidity of its growth has repeatedly outdistanced the municipal regulations so that it has several times happened that what was considered first-class work at one time would not be tolerated three years later. The effort to have things right which is manifested by this code certainly deserves every encouragement.

ARCHITECTS' AND BUILDERS' DIRECTORIES.

WE have had sent to our table two recently published directories of architects and builders, one embracing the State of Connecticut, and published by the Record Publishing Company, of New Haven, Conn., and the other embracing the State of Wisconsin, and published by the Builders' and Traders' Exchange, of Milwaukee. This latter work is made especially interesting by the incorporation into its make-up of many pages devoted to the consideration of questions which arise in connection with the building business, such as Mechanics' Lien Laws, Rules and Conditions for Estimating Work, Hints to Contractors, Information for Masons, Laws relating to Buildings, Plumbing, Sewerage and Sanitary Laws, and other matter of value to architects, builders, and contractors, the whole work having been compiled by W. H. McElroy, Manager of the Exchange.

Brick versus Wood. I.

BY R. CLIPSTON STURGIS.

IN the following articles I propose to treat briefly, first, the advantages of brick over wood; second, the adaptability of brick to all circumstances of climate and all classes of buildings; and third, a consideration of the means for promoting the more general use of brick.

In this article, then, I will consider the durability, economy, and beauty of brick as compared with wood. For one who understands the possibilities of brickwork, it is difficult to see why it is so often passed over as a building material and wood chosen instead. It can be only ignorance which will lead to such a result. There seems to be a prevalent idea that brick is very well in the cities, where, indeed, one must use it, but that wood is the right and proper material for suburban or country houses.

This is, indeed, a natural position to be taken by a primitive people, or a people who are painfully and with labor settling a new country. With them the timber which surrounds them, and which must be cleared to permit tillage of the soil, does, indeed, present

ST. ALBAN'S ABBEY.

itself as the natural material of which to build. Such a people were we when this country was first settled, and as, perforce, we then built of wood, gradually we evolved from the new surroundings and the necessities of wood construction a style quite essentially our own — the classic of the Renaissance reproduced in wood.

But we were not a primitive people even then, and we do not now live in a primitive country; wood is no longer the natural material which comes first to hand. Neither our spruce nor our pine grows now at our door. Even for a country house in Berkshire, or Mt. Desert, the material for a wooden house will largely come from far.

The wooden colonial house of New England was beautiful in its own way, and was a natural and lovely outgrowth of necessity, but the brick colonial house is quite as beautiful in itself and much more in keeping with our life and civilization. The brick house

to-day, as the wood in primitive times, is the fitting and proper house. It is more durable; it is — partly because of its durability — more economical, and admits of a wider range in things beautiful,

BROWN & DURRELL BUILDING, BOSTON.
Winslow & Wetherell, Architects.

because a permanent material has in itself elements of beauty which a perishable material can never have.

For the three reasons of durability, economy, and beauty, we should certainly think twice when we are planning to build before we accept wood as the best material for our house.

First, brick is more durable than wood. It will stand dampness; it will stand heat. A brick, although more or less porous, is not injured by being exposed to damp. Even the severe test of alternate wet and freezing will not disintegrate brick (as it will many kinds of stone).

It is true that dampness must not be allowed to penetrate a wall to the inside, but precautions which will prevent this are so simple as to make the disadvantages of this hardly worth considering.

Nor is it subject to destruction by fire. It has come to perfection in the heat of the kiln, and is better adapted than any other material to stand the test of extreme heat and sudden cooling with water. Few stones will bear this. And if stone hardly bears comparison with brick on these two points, how much less does wood, which rots when exposed to damp and burns when exposed to fire. Wood will rot from damp; it will rot from lack of air. It will burn. It is not as good a non-conducting partition, even when in perfect preservation, as a vaulted brick wall. It has no permanency. Everything tends to wipe away from remembrance all memorials of an age of wood.

Where are all the fine old colonial houses of Boston, which once were its glory? Gone! Some to make way for modern buildings; more fallen in decay and in the lap of devouring flames. What an indescribable loss it is to us that so many of our buildings, historic now, and ever becoming more so, are so often mere frame buildings, subject to decay, an easy prey to fire. The pity of it! For we cannot help it now.

We may be thankful that the walls of Independence Hall, and of the Old State House of Massachusetts, and of Faneuil Hall, are of brick; and it would have been well to-day if the ornament and outside finish of those buildings had also been of imperishable material, instead of wood.

It is not, however, because men think wood especially durable that it is so often advocated. The general plea is economy. Now, a material which is perishable must be very cheap indeed if it is economical in the long run as compared with its more durable substitute. A suit of clothes which with three months' wear is faded and worn must be cheap indeed to be as economical as one which will wear as many years and yet hold its color and its texture.

In the case in point the wood building is not by any means sufficiently cheap to bear comparison with its durable brick counterpart. For the saving lies wholly in the outside walls, that is, those that are above grade. The foundations for an ordinary house, for example, would be the same in either case, and the cost of the outside walls is, after all, not such a very large portion of the total cost. The foundations, the inside carpentry, floors, stairs, doors, windows, and finish, the plastering and plumbing, are not affected by the material of the outside walls, and the painting and heating, if affected at all, are in the direction of a reduction for the brick-walled house. It is on the walls only that the cost comes, and on these it might make a difference of eighteen or twenty dollars for every hundred square feet of wall. One can easily calculate what this would amount to on any given house. On one of tolerable size and cost it would probably be not more than five per cent. of the total cost.

And as an offset to this, one has a yearly saving in repairs and insurance, — this on the hard cash side; and then the comfort — not to be reckoned in dollars and cents, but worth dollars and cents notwithstanding — of feeling that one is well housed in a house that will endure, that protects you from winter's cold and summer's sun — as the wood will not — and that will outlive your day and perchance cover your children's children, and yet, again, their children. There is something in that not to be overlooked and yet difficult to reckon: that love for the old homestead which comes only through long years

HOUSES, BEDFORD PARK, LONDON.
R. N. Shaw, Architect.

of possession, which, in turn, breeds love for one's own town, for one's own State, for one's own country — the best and purest patriotism, which has its roots deep down in the home.

It remains only to show that brick is essentially more beautiful

PALAZZO COMUNALE, PIACENZA.

than wood, and then, I think, we shall have a fairly strong case for the brick house.

This is, of course, the hardest point to really prove; indeed, we might call it impossible of proof, for even those most competent to judge might differ. I will therefore only say why it seems to me that brick is a more beautiful building material than wood.

First, then, because after it has got the stamp from man's hand which shows it to be man's handiwork, and therefore fit and suitable for his needs, thereafter it is never touched again by aught but Nature's hand, which softens its rough or its too fine edges, covers it with bloom and beauty, and makes it year by year more lovely, until even in its decay and ruin (generally wrought by man) it is lovely yet. Look at the ruins of the Roman baths, Tattershall Castle, or that grand old tower of St. Albans. There are ruins which are beautiful, and good old stalwart brickwork, lovely in its age.

Now you cannot leave woodwork alone and yet have it preserve its usefulness. If left to weather and to be treated by Nature's hand, it does, indeed, become lovely. What more lovely in color and texture than a weather-stained board or shingle, or a water-washed or worn plank? But it is no longer fit for work. It is either not sound, or not tight, or not strong. No! we must protect our wood from the weather and keep it with oil or white lead, or else be constantly renewing it. Our house, then, always looks spic and span — nice enough in its way — or else shabby and disreputable.

It is the old story, our house is best when new; it doesn't improve with age; it must be constantly renewed to keep its value. But our brick house is worst when new, and grows yearly better and better. That is the kind of investment that I like, and that is one reason why I find it more beautiful.

The second reason is that it is a material which allows, and indeed demands, that its construction shall show. The wooden skeleton, the frame, is covered and protected, outside to keep out the weather, inside to cover its ugliness; but the brick-builder glories in his brick, and he finds in the necessary constructional bonding a chance for beautifying his wall, in his arches again an opportunity, in the vaults again another, and he need not be ashamed to show his brick wall inside. On this side of the case the constructional beauties of brick as a material might go on indefinitely. I trust I have said enough to at least set others thinking, even if I have not carried conviction.

As illustrations I would refer to Westover, in Virginia, a familiar but always lovely example of the best sort of colonial work. The tower of St. Albans (a sketch of which is given), dating back to 1200, now flanked by Gothic nave and nineteenth century additions which look almost trivial beside this massive old tower. The town hall of Piacenza, in brick and terra-cotta, and the apse of the church of the Frari in Venice, which has previously appeared in THE BRICKBUILDER, as examples of the ornate and the simple brickwork of Italy; and as similar contrasting examples in modern work, McKim's elaborate façade of the Century Club and Wetherell's quiet warehouse for Brown & Durrell, both excellent examples, and hard to beat in their way; and, finally, some very modest English work,

CENTURY CLUB, NEW YORK CITY.
McKim, Mead & White, Architects.

the lovely old Emanuel Hospital, at Westminster, now, I believe, swept away for modern improvements, and one of Norman Shaw's little houses in Bedford Park, a suburb of London, which owes nearly all its interest to what Shaw has done for it.

IT would be difficult to give stronger evidence of the intrinsic effect of a good colored material than is afforded by the fact that designs so really ignorant in their architectural detail as most of the buildings of the time of William III. and Queen Anne should, nevertheless, have a certain charm for us, solely derived from the beautiful color of the bricks with which they are built. — *Street.*

Architectural Terra-Cotta.

BY THOMAS CUSACK.

(*Continued.*)

THE advantage of jointing terra-cotta into reasonably large blocks received passing notice in the concluding paragraph of last article; but what constitutes a block of reasonable size is a question that was not, and, indeed, cannot be stated in the abstract. Within extreme limits, the size would depend upon its shape, the character of the work, and the situation it has to occupy when it reaches the building. One block contains, say, 240 cu. ins., another over 28 cu. ft., yet in both cases the size has been determined by the foregoing circumstances, without reference to the fact that one is but a two-hundredth part of the other, weighing 10 and 2,000 lbs. respectively. We have recently seen some excellent blocks of the latter size made and burned with complete success. These, we admit, were exceptionally large, but they served to prove what it is possible to do in this direction under favorable conditions as to shape, and in situations where large blocks are really necessary. Some manufacturers err in their indiscriminate advocacy of small blocks, forgetting that there are other things besides size to be considered. As it is always the poor workman who quarrels with his tools, so it is the poor terra-cotta maker who resorts to inordinately small blocks as a desperate remedy for ills that are otherwise, and at times, easily preventable. Degenerate types of the human family show a tendency to get back to barbarism, as an escape from the duties of advanced civilization. In a similar way do those who get behind in the well-contested race of architectural clay-working fall back upon less exacting forms, until they reach their level in the primitive simplicity of a brick. In the face of all that may be said to the contrary, we repeat that to joint work into needlessly small pieces is *not* the alpha and omega of architectural terra-cotta making.

The actual size of a block in cubic inches has no meaning unless accompanied by the qualifying conditions that have just been referred to. Its relative proportions, and whether it could be molded on the widest dimension, as distinguished from the end or side, are among the technical things that an experienced terra-cotta maker would want to know before venturing an opinion. There is no formula by which even an approximate size may be fixed that would hold good in all cases. The nearest approach to one may, perhaps, be embodied in the following proposition. Let it be laid down as an abiding desideratum: First. That the block shall not crack in drying, and, having been burned at a high temperature, that it remains sound on all sides. Second. That its lines be practically true (they need not be mathematically so), its surfaces free from warping, and its shape as correct as the plaster model from which the mold was made. Third. That the maximum variation from exact size required shall not exceed one eighth of an inch in a block of, say, 3 ft., the same ratio being maintained in those of smaller dimensions. We would then say, let the rule be to make blocks *as large as practicable, subject to the foregoing conditions.*

It will be observed, however, that this rule is somewhat elastic for the size of our block, if not altogether an unknown, is, as yet, an extremely variable quantity. So it is, and so it must remain. Just what would be considered a practicable size might, in a measure, depend upon the color that had been selected, clays of different colors being more or less stable, and more or less tractable in their behavior. Account would likewise have to be taken of the plant and appliances to hand for drying and handling the blocks after they had been turned out of the mold. But these and other things being precisely equal, most of all would depend upon the skill, experience, forethought, and unceasing watchfulness of the man (or men) under whose direction the work is made. In like manner, but in a lesser degree, an important item towards success or failure must be charged to the account of care*ful* or care*less* handling. This would apply to every man through whose hands the blocks had to pass, from pressers to kiln setters. Thus does the actual result rest directly, and almost entirely, on an individual and distinctly personal basis. The form, finish, and degree of mechanical excellence in every block reflects the personnel of the men engaged in its production.

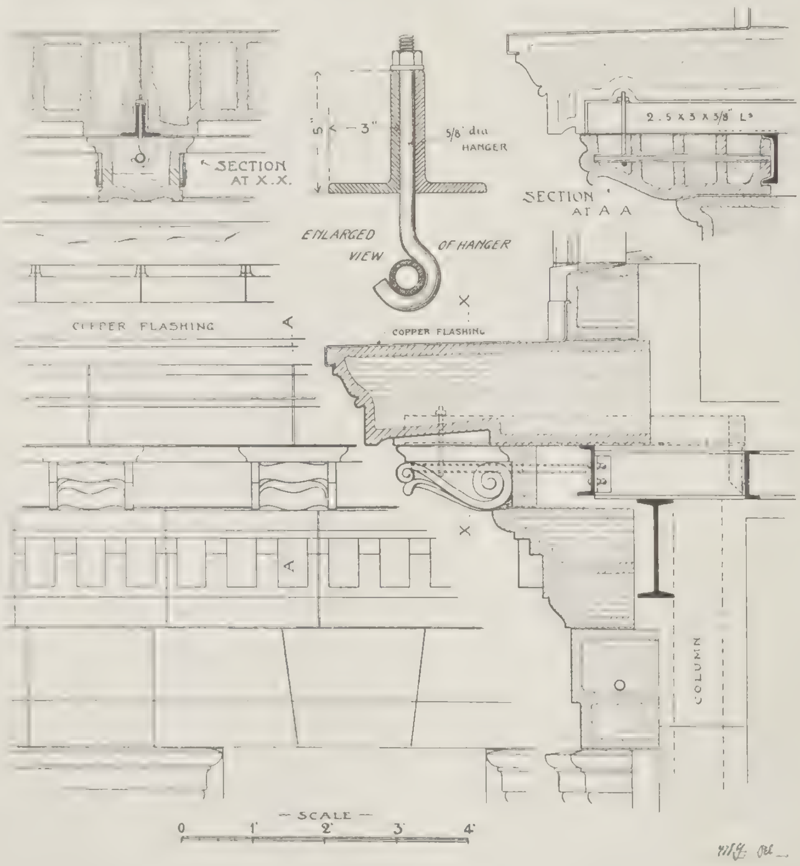


FIG. 26.

Let it be understood, once and for all, that in this department of terra-cotta making there is little, if any, room for automatic machinery. The only mechanism available for work of this kind is the head and hands — perchance the heart — of an individual man, or number of men. Not only does it represent the individual effort of mind and body acting upon matter, but every block of it becomes intensely human in all the excellencies or defects of its manipulation. As one man differs from another in intellect, training, and force of will, so does his work differ in accuracy, finish, and reliability. What is true of individuals is equally true of organized bodies; and the quality of their work in the aggregate will carry with it the indelible impress of their organization, as well as of their individuality. This is why the work of particular firms may be recognized in most cases by its unerring ear-marks. Whether viewed in a spirit of comparison or of contrast, the observant critic finds little difficulty in tracing its origin, or in forming a fairly accurate estimate of the men entrusted with the making of it.

Most of these observations apply to the making of terra-cotta in general; but some of them have a significant bearing on the matter now in hand, which has to do with the construction of heavy cornices. In work of this kind large blocks, though, perhaps, not always absolutely necessary, often become of vital importance. The extra size required is, in a measure, compensated by the nature of the situation; and it in turn makes the conditions of manufacture less exacting, therefore more favorable to the production of large pieces. The reasons why this is so were given with sufficient detail in connection with Figs. 23 and 24. But in Fig. 26, where we have

a cornice of much greater weight and projection to deal with, the same considerations hold good. The projection in this case is 3 ft. 6 ins., with 1 ft. inside the wall line. The modillions are spaced, some on 2 ft. 10 in., and some on 3 ft. 2 in., centers; and as the spacing determines the length of the pieces, their dimensions averaged 4 ft. 6 ins. by 3 ft. by 1 ft. 5½ ins., which is equal to 19 cu. ft., and would weigh about 1,200 lbs.

It may not be out of place to mention that these blocks were used on the new Astoria Hotel, 34th Street and Fifth Avenue, New York City (Fig. 27), where one hundred and fifty of them were required for the cornice at the twelfth story. Not one of these blocks being in any way defective when taken from the kiln, the original number was shipped, and set in the building without misadventure. For one of them see Fig. 28. Several mitres — some of them being both internal and external — of still greater size were made at the same time with equal success. Their dimensions were 5 ft. 1 in. by 3 ft. 11 ins. by 1 ft. 5½ ins., and the weight close upon a ton. Even with these, the limit as to size did not appear in sight, if we except the door into kiln, which was only large enough to receive them without any room to spare. These blocks, be it observed, conformed to the conditions just laid down as the governing factor; whether it be in the absence of cracks, trueness of line, or accuracy of shape.

FIG. 27. ASTORIA HOTEL, 34TH STREET AND FIFTH AVENUE, NEW YORK CITY.

H. J. Hardenbergh, Architect.

We now turn to the scheme of construction which, having been approved by the architect, and accepted by the engineers, was carried out exactly as shown in Fig. 26. The chief advantage in the use of two L's instead of an inverted tee is that it allows the hangers by which the modillions are secured to pass up between them. This furnishes a ready means of adjusting the modillions to line, by giving a few turns to the tension nut. The cantilevers so formed are thus made to act in a dual capacity; in suspending the weight of the work below, and supporting the much greater weight of that which rests on top of them. The strength of the modillions is greatly increased by the pipe — or, better still, bar of iron — that is passed through them before the chambers have been filled with concrete. The ends, being shaped to fit into the 8 in. continuous channel, makes them less dependent upon the hangers, which, however, it is well to have in case of accidents. This channel is bracketed to the outer end of floor beams, and acts as a fulcrum to the cantilevers, the ends of which are similarly secured to short pieces of channel introduced *between* the floor beams. The whole weight is in this way transmitted to the 16 in. I beam on which the floors rest, and it is really part of the structural framing between the columns.

FIG. 28.

We would call attention to the metal covering on the top surface, which we consider a wise precaution. It is not that a single block of this cornice really needs protection on its own account; unprotected it would certainly outlast the copper. The vulnerable point in all work of this kind is not necessarily inherent in the blocks, but in the joints between them. The mortar or cement is liable to wear out; and the repointing, which should be done every five years, is usually neglected altogether. This allows the water to gain access to the iron, and when that occurs, we fear it is then only a question of,— how long before it perishes?

BRICK PORCHES AND FENCES.

IT is remarkable what very ornate porches may be constructed by a judicious selection of brick. We have seen entrances to mansions built entirely of this material that far outweigh in grandeur and cheerfulness the ponderous stone columns that would appear to be indispensable to the building of many of our country mansions. In fact we have seen a red brick porch added to an old farmhouse built of stone, that, far from looking incongruous, was a decided attraction.

For fences there is nothing better than bricks. Pretty well any quality of brick can be used, and it is the only form of fence that age does not wither nor time decay. Where wood fences are used there is always the rotting of the foundations to contend with, and much necessary painting or tarring to be done to the superstructure. Architects do not sufficiently know what lasting walls can be made by cast-off bricks, and what added charm is given to a house when lichen and creeper have added their finishing touches.— *The British Brickbuilder.*

WITH this issue, the continuation of Choisy's "The Art of Building among the Romans" is resumed. This work will now be published in successive numbers until completion, requiring probably four.

The Art of Building among the Romans.

Translated from the French of AUGUSTE CHOISY by Arthur J. Dillon.

CHAPTER III.

CONSTRUCTION IN WOOD.

GENERAL REMARKS ON THE METHODS IN USE AMONG THE ROMANS.

(*Continued.*)

IN these modern works, the squared timbers are frequently superseded by round ones, and the cleats by withes or cords. This elementary method of fastening was also much used by the Romans; or, at least, this may be deduced from the text where Vitruvius describes how ceilings imitating vaults should be constructed by means of poles firmly bound with slender stalks of flexible wood; and this is also brought out in the description the same author gives of the construction of caissons used in laying concrete under water.[1]

Of ancient wooden bridges there are really but two examples; the bridge over the Danube, built by Trajan at the time of his expedition against the Dacians, and the bridge over the Rhine, built by Cæsar, to facilitate the incursions of the Roman armies into Germany.

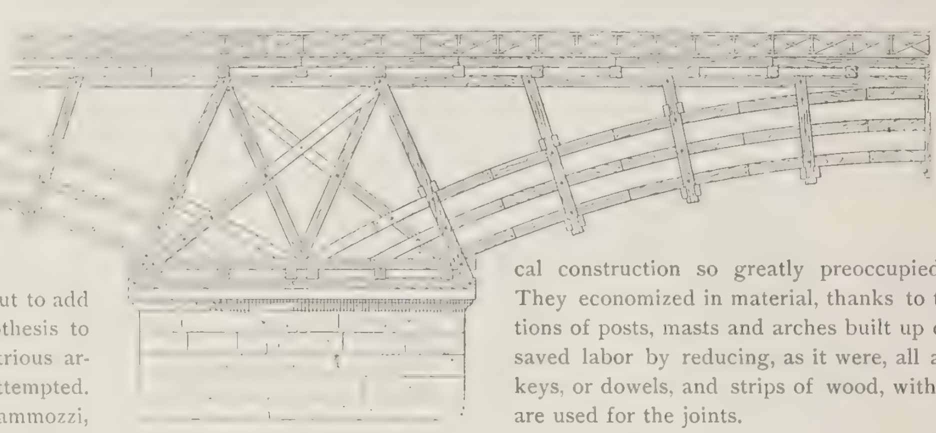


FIG. 95.

The bridge across the Rhine has been so often reconstructed, according to Cæsar's description, that to attempt still another restitution of it would be but to add one more disputable hypothesis to those which so many illustrious architects have vainly attempted. L. B. Alberti, Palladio, Scammozzi, have tried to interpret the text, and their efforts have only served to show the difficulties of the question; all agree that the platform rested on beams whose ends were fastened between two piles; but their agreement stops here. As soon as it is a question of the details of the structures, of that method of assemblage which, according to the expression of Cæsar, was strengthened by the effort of the current, one finds as many opinions as there are translators. It is sufficient to mention these numerous attempts; all seem very imperfect, but it is much easier to perceive their imperfections than to correct their errors.

As for the bridge over the Danube, the difficulties of its restoration are of an entirely different nature; for here it is a question of interpreting a strictly conventional view, which is almost as vague as the representations of the monuments in the landscapes of Pompeii, and which recalls only by a few characteristic traits the aspect of a Roman bridge.[2] Figure 95 gives the most important details shown on the bas-relief of Trajan's Column.[3]

[1] Caissons of beams fastened with withes (Vitr., Lib. V., cap. 12.).

Imitations of vaults made by means of curved panels of wood with ligatures, keys, and plastering (Vitr., Lib. VII., cap. 3. Cf. Pall., de re rust., Lib. I., cap. 13; Vitr. compend., cap. 21).

[2] Many critics have even thought, through faith in Dion Cassius (Epit., Lib. LXVIII., 13), that the bridge shown on Trajan's Column is in no way a representation of that over the Danube; the latter, according to them, was entirely of stone. But this is a question of no interest to us; it suffices that the bridge shown on the column is a Roman type of bridge. Nevertheless, we may note that in representing the Danube bridge to be of wood, the bas-relief agrees with an engraving of a medal in the National Library, where are to be seen the three distinct arches as well as the ties that bind them together: the medal shows these ties vertical, while in the bas-relief they converge, and this is the only noticeable difference between the two figures.

[3] The tinted parts in Fig. 95 are those shown in the bas-relief: the restorations are shown in outline only.

Three concentric arches form the active part of a truss; these arches are bound together by ties that extend up to the level of the platform, holding the string pieces and supporting the flooring. Above the piers, the platform is carried on trestles. Such is the bridge reduced to its essential parts. As to the accessory pieces, cross-braces or others, the maker of the bas-relief has left us in ignorance; this omission is permissible in a figure meant only to fix the place of an event; but it is to be regretted that it leaves so large a field open to conjecture. The arches, in the bas-relief, have no abutment, and it is difficult to understand the cross-bracing between the trestles; I have prolonged the arches to their meeting with the piers, and have considered the cross-brace between the trestles as continued to the level of the platform. These were, it seemed to me, the least changes that could be made in order to make the bas-relief of Trajan's column practicable; and everywhere else I have conformed to the model. The bas-relief leaves the question of the material of the arches entirely unanswered. It is clear, however, that these large pieces were built up of small beams; it can even be said that their construction recalls that of the corner posts of the towers of attack previously described. It was Apollodorus that described them, and it is Apollodorus who is thought to be the architect of the Bridge of Trajan.[4] But here positive evidence begins to become scarce, and to go into a more extended discussion would only lead to hypotheses which seem at the best useless.

These few examples, some borrowed from modern construction, will, I believe, help by analogy to a conception of the temporary framing, the scaffolding and centering whose economical construction so greatly preoccupied the Roman builders. They economized in material, thanks to their ingenious combinations of posts, masts and arches built up of small pieces, and they saved labor by reducing, as it were, all assembling to that where keys, or dowels, and strips of wood, withes and ligatures of rope are used for the joints.

Furthermore, whatever may have been the character of its applications, whether temporary or permanent, the art of framing was subject, to the same extent as the other branches of architecture, to the entirely local influences of resource and of traditions.[5]

Roman Egypt, as well as the Egypt of the Pharaohs, seems to have been devoted to the use, for building timber, of long stems, interlaced or held together by bonds of rushes (Strab., ed. Cas., p. 768 and 822).

Africa, at the time of Sallust, had an entirely distinct type of roofing, which recalled in appearance the hull of an overturned vessel, and which seemed the result of the effort to avoid the effects of the winds of the desert (Sall., Jug., cap. 18).

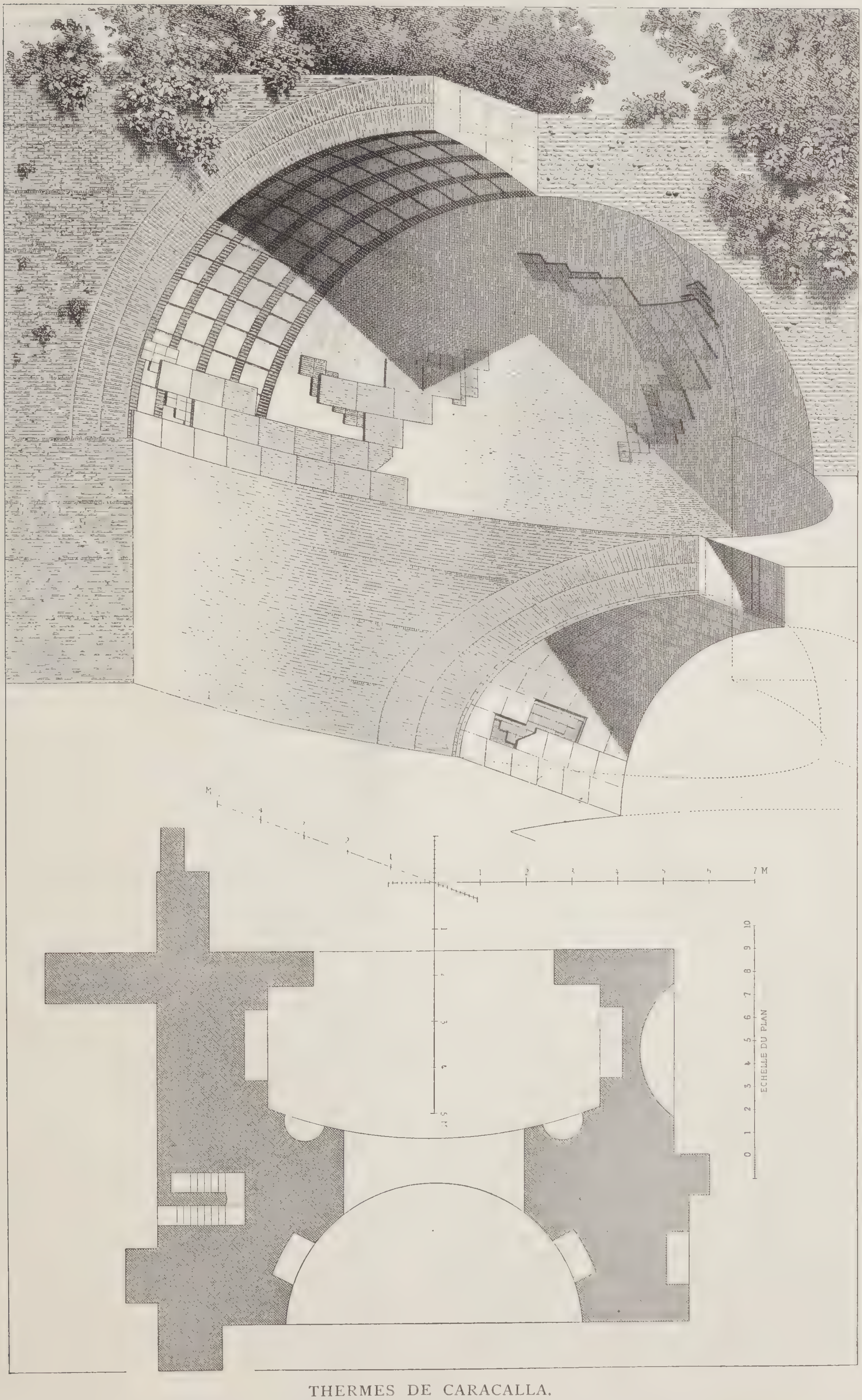
In Colchis, and without doubt in Arcadia, it was the use of round pieces, such as those used in the cottages in the Alps to-day, that regulated the entire system of framing (Pausan., Arcad., cap. 10; Vitr., Lib. II., cap. 1).

In Lycia the wooden buildings, made of panels interrupted at frequent intervals by strings of strong horizontal pieces, and covered by roofs of saplings, seemed to hold a middle place between the ordinary buildings and those with solid walls of horizontal trunks of Cholchis (see for the sculptures showing these constructions, the works of MM. Texier and Fellows).

In the Orient, at the extreme limits, or even beyond the frontiers, of the Empire, we find that the chief characteristic was the use of forked posts, from which came that type of the bifurcated columns that are so numerous in the ruins of Persepolis.

[4] Procop., de Adif., Lib. IV., cap. 6.

[5] I am indebted to M. Viollet-le-Duc for having called my attention to these local characteristics of ancient framing.



THERMES DE CARACALLA.
PLATE XII. THE ART OF BUILDING AMONG THE ROMANS.

Finally we come, in the midst of the forests that covered the soil of Gaul, or the country of the Marcomans or of the Dacians, to the masses of tree trunks, piled up in layers, sometimes mixed with rough or hewn stone, forming entrenchments, piers of bridges, fortifications on the banks of rivers—all that series of strange structures whose spirit is shown us in "Cæsar's Commentaries" and in the bas-reliefs on the columns of Trajan and of Antonius, and whose tradition has been preserved in Switzerland down even to the present time. I must limit myself, however, to the mention only of this variety of forms and methods, as well as of the double influence of local customs and natural resources which justifies it in our eyes, and which made it inevitable among the ancient peoples.

REVIEW OF THE METHODS OF ORGANIZATION OF BUILDING OPERATIONS.

We finish here the examination of the methods of Roman construction: we have studied them in turn in the monuments built of concrete, in those of cut stone, and, as far as possible, in those of wood; we have separated and presented individually each of the parts of an ancient edifice; it is now the time to bring these elements together, to show them put into practice, and to indicate, at least by one example, the spirit of organization that ruled the great enterprises of construction. The practical art of the ancients was not, in fact, a simple combination of methods united by a community of principles; along with and above individual methods, the Romans introduced certain ideas of sagacious discipline which stamped their great architectural enterprises with the mark of that order and regularity which their political genius gave to the whole administration of the Empire. In a word, the Roman art of building was a matter of organization, and it is under this new aspect that we must now consider it. The Coliseum seems the building whose analysis will throw the clearest light on the general principles, so we will describe it both in relation to the organization of the workyards and to the general progress of the work.

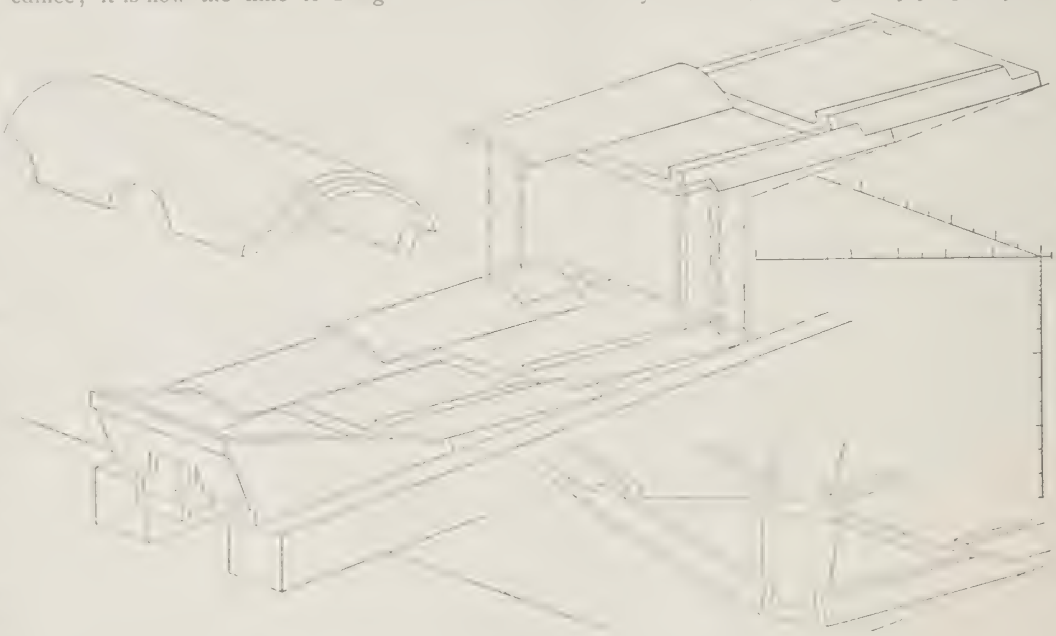


FIG. 96.

Plate XXII. gives a section along one of the radiating galleries of the Coliseum; the different tints show the different materials: the stones whose surface shows in a lighter tint against the more deeply colored background of the filling are blocks of travertine; the other stones are of a more common material, the compact volcanic tufa which, under the name of "peperin," is quarried at several points of the Roman Campagna.

The travertine is only employed, as can be seen, for the heads of the walls and for two intermediate piers — M and N — intended, without a doubt, to sustain heavy constructions, of which the idea was afterwards abandoned.

Without stopping to question what rôle the piers of travertine play, or were intended to play, in the edifice, we will note only their construction. Their courses bond, course for course, exactly with the courses of the filling. But this is not at all true for the heads of the walls, A and B. The courses of these pilaster-like heads run with the courses of the walls they terminate in the most incomplete, the most irregular, one might almost say, the most awkward manner. I show, in order to make the contrast more evident, the two cases of bonding; the first figure, Fig. 97, shows the imperfect bond between the heads and the walls; the other, Fig. 98, the regular bonding of the walls of tufa with the piers of travertine built in them.

At the first glance one is shocked by this so apparent incongruity; but closer examination finds in it an indication of one of those artifices of organization which the Romans introduced so happily into their great enterprises in order to simplify the progress and make it both surer and more orderly.

Evidently the disaccordance of the courses of the heads and the body of the wall cannot be justified by taking for its explanation only the difference of materials and the difficulty of quarrying the stone of Tivoli in blocks of the same height as the stone of Gabies or of Albano; the same difficulty would have existed in the bonding of the walls with piers such as M and N, which divided them. Yet, between the courses of the piers of travertine and of the walls of tufa, there can be seen (as we said above) none of those interruptions of continuity, none of those singular breaks; why then were they admitted, one might say purposely multiplied, in one case, and so carefully avoided and entirely proscribed in the other? The courses are not more regular in the heads than elsewhere, but their heights are different; only a few insignificant bond stones run into the filling of tufa; almost in every case these bonds cut the courses of the filling midway in their height, and chance only seems to have brought about the rare cases of accordance. Surely, the only hypothesis that can give a reason for these apparent anomalies is this — that the heads were built first of all; and afterwards the body of the walls, including the piers M and N, which strengthen it, was built.

This manner of proceeding is foreign to our customs, but its motives and advantages can be easily conceived. The pilasters A, B, C, once constructed about the entire perimeter, formed a sort of general plan in relief of the amphitheater whose utility can readily be perceived. We have here, in fact, an edifice whose plan is extremely complicated; the Coliseum comprised innumerable galleries and a great system of stairways and passages, hardly to be traced in the ruins, and much more difficult to distinguish in the midst of the disorder and confusion of the building operations. The builders were continually exposed to mistakes of all kinds when fixing the position and arrangement of so many diverse parts; and one can comprehend that the pilasters surmounted by arches, when built about the entire circumference, changing in form whenever the orientation or the shape of the stairways changed, would be of great assistance in limiting the field of errors and, as one might say, in rendering all doubt impossible in spite of the intermingling of the parts of the plan and of the multiplicity of its parts.

This separation of the work into distinct parts had another result not less important; it allowed it to be distributed among very distinct categories of workmen.

The pilasters A, B, C, and the arcades whose thrust they received, belonged to one class of workmen, to one series of operations;

the body of the walls to another; and in each the same operations were repeated without cessation. It was therefore possible to divide the workmen into two entirely distinct classes and to employ them according to their greater or less skilfulness or aptitude; it was, it may be said, an application of the ideas of modern industry on the division of labor. All the details, moreover, emphasize and explain this view.

In the lower story, the piers M and N bond with the filling; this because the piers and the filling differed only in the quality of the materials; the manner of building was the same, the care taken in the cutting was the same for both parts, and this entire portion of the edifice could be confided to the same workmen, hence a division such as that which existed between the walls and the heads had here no reason.

On the other hand, when the first floor level was reached, the cutting of the filling became less regular than that of the piers M and N. The courses of tufa were frequently interrupted; stones of all sizes were used and built in no regular determined order; here there was an occasion for a division of labor; and in fact, the bond between piers M and N and the filling was abandoned; the piers, up to this point cut with alternating long and short courses, suddenly became independent pillars, all of whose faces were vertical and continuous; the filling was butted up against these so that no bond whatever was obtained from the shape of the stones, as shown in Fig. 99.

If the architect thought this independence of parts justifiable when both piers and filling were built of cut stone, there was still greater justification for it when at the level of the second story he abandoned the use of cut stone in the filling and contented himself with rubble work with brick facing. Hence the piers of traverine — M and N—had in the entire height of the second story no bond with the walls; the faces of the piers were vertical, and the rubble was simply butted against them.

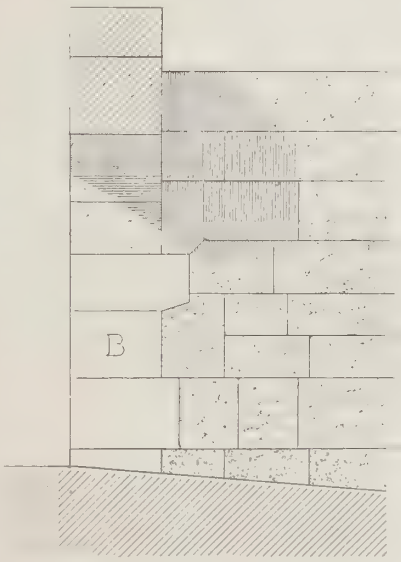


FIG. 97.

This example, moreover, is not the only one; the necessity of juxtaposing rubble walls and cut stone pilasters again arose in the parts of the radiating walls nearest to the arena; and in both cases there was the same solution of the same problem. The body of the wall at it slower parts, C–D, was of rubble with brick reveting; and here again all bonding between the walls and the cut stone pilasters terminating them was omitted. Instead of tieing into the rubble by alternate projecting and retreating courses, the sides of the pilasters were straight and smooth, and the different kinds of work joined, touched each other, but remained entirely independent.

These were the principal expedients in the construction of the Coliseum. In general, one should notice the great variation in the sizes of the stones. Throughout the edifice there is an entire lack of uniformity; while, on the other hand, other Roman buildings show, in unexpected contrast, a regularity of cutting that is not less systematic and curious; such, for instance, as in the case of the voussoirs of the bridge of Gard. In fact, however, there is here no anomaly, and the two contradictory systems show less a divergence of method than the concession made to the difficulty of quarrying uniform blocks from such stone as travertine. Through principle the Romans sought uniformity of size in their materials; and they desired to obtain it not only in their construction in stone, but also in their framing, especially in rapidly constructed works. Thus (as above) all the timbers for an attacking tower were of the same scantling, and all were cut from pieces either 16 or 9 ft. long; to adopt such a system was to accept waste, be it in the forest or the quarry, but at the same time it was to become free from one embarrassment by removing the bond between the lumber yard and quarry and the carpenter shop and cutting shed.

This separation which we have just noted between the various parts of a building becomes manifest in a still more striking manner if we pass from construction to ornament.

In the buildings of cut stone, the builders nearly always left the stones roughed out, and other workmen afterwards cut the ornament on them. Sometimes moldings, because of their importance, had to be cut in place, and then they were cut on stones independent of the body of construction and separately executed. Thus the Romans were careful not to cut the very salient molding (Fig. 100), that runs like an archivolt about the opening, on the voussoirs themselves; and, following the example of the Etruscans, they gave it its own ring of stones and cut it after it was put in place.

The same independence existed, as we have seen, between the wooden framing and the ornaments which decorated it: these latter for the most part being carved or painted pieces nailed on the beams of the framing or in the panels of the carpenter work.

But it was above all in the concrete structures that the separation between the construction and the ornament was most manifest. The Roman built; others then took up the work and assumed the task of embellishing it. They applied stucco, reveted it with marble, covered it with ornamentation, more or less beautiful, but which was exacted by no necessity of the construction, nor even announced by its disposition; do away with this envelope and the first conception will still exist in its prime integrity, so independent is the ornament of its background, of the structure of the edifice it decorates. And this is not a theoretical distinction: the division existed to such a marked extent that often the applied decoration covers and dissimulates facings whose elegant arrangement becomes superfluous when their surfaces cease to be visible. It is not rare to see the Romans thus complete their tasks as builders without preoccupying themselves about the final appearance of the edifice, and lay the small stones of the rubble or the bricks with an evident care on the surface of walls, which the decorator, who came after, was to cover with slabs of marble or coatings of precious materials. As examples of this I reproduce (Plate XV., Figs. 3 and 4) some wall surfaces of arcades taken from monuments where they were to be concealed by thick veneering or revetting as soon as they were completed. The first example comes from the ancient tower of Autun, known as the Temple of Janus; the second from the Mausoleum of Augustus. One feels impelled to say, at the sight of these carefully built surfaces, in which the Romans themselves had no profit, that they feared the proximate ruin of the rich covering, and, desirous of leaving a souvenir to posterity, thought, perhaps, of the time when their works would appear as they show themselves now, deprived of all applied ornament.

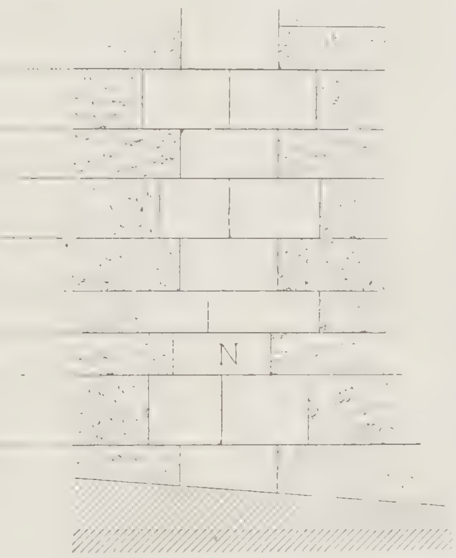


FIG. 98.

But I would prefer to see in this care of the wall surfaces an expression of an entirely practical idea, that of allowing the diverse

corporations the greatest possible initiative; each thus had its part in the responsibility for the success of their common work, as each had its part in the choice of the means adopted. Each class of artisans remained, to a certain degree, the judge of the methods to be followed, and this privilege was used, as is known, by observing in the practice of the art certain traditional rules, which the organization of the workmen's corporations, perhaps somewhat narrow, made obligatory for all the individual members. The mason was not aware of what decoration would be applied to the walls; he constructed them according to certain admitted methods, and, whether they were to be covered by veneering or not, his methods were the same, the mass of the wall was built in the same manner, and the same care was given to the arrangement of the wall surfaces. Sometimes useless attention was given to work that was to be concealed by future decoration; but, on the whole, the uniformity introduced into the methods of work resulted in more rapid construction; and this was the main point in the eyes of the Roman architects. Under a social régime, when public monuments were often erected at the cost and by the orders of temporary magistrates,[1] rapidity was the first condition to be met, and the exigencies of decoration seemed hindrances from which it was useful to be free for the time being. Attention given to these matters during the preparation of the projects, and while carrying them out, would have involved inadmissible delay.

It is thus explainable why the Romans never accepted the system of construction of the Greeks except for temples, for façades of monuments or for buildings "*de luxe*," and of little importance. A system of architecture such as that of the Greeks, where the form is

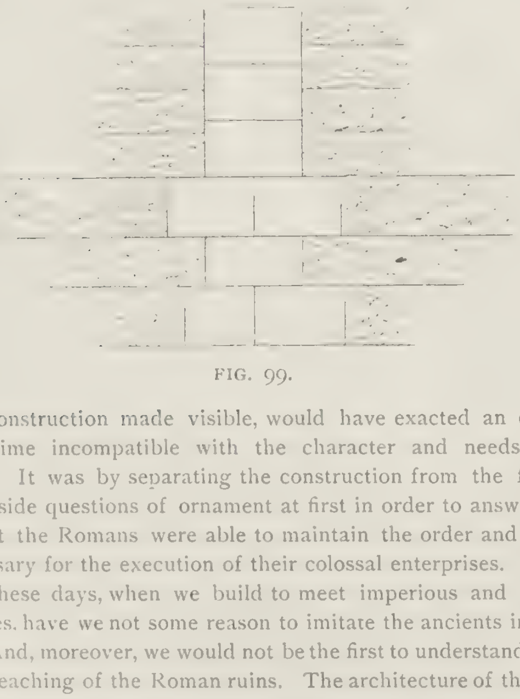


FIG. 99.

but the construction made visible, would have exacted an expenditure of time incompatible with the character and needs of the Romans. It was by separating the construction from the form, by putting aside questions of ornament at first in order to answer them later, that the Romans were able to maintain the order and simplicity necessary for the execution of their colossal enterprises.

In these days, when we build to meet imperious and pressing necessities, have we not some reason to imitate the ancients in this respect? And, moreover, we would not be the first to understand and follow this teaching of the Roman ruins. The architecture of the Italian Renaissance shows us continual and remarkable applications of it. The Roman idea of separating the decoration from the structure was never more in favor than in the sixteenth century in Italy. This can be seen, if need be, in the writings of that time (see, among others, Serlio, Liv. IV., p. 189, edit. of Venice). Still better, however, is it shown by the uncompleted edifices of that epoch, which are, for the greater part, rough masses of masonry, with recesses left for placing cornices and architraves, accessory ornamentaion which it was the custom to put in place afterwards. The architects of the Renaissance could have taken this practice directly from the ancients; bu there was no need of reviving the Roman tradition, for it had been followed in Italy, during all the middle ages; and the idea of sepa-

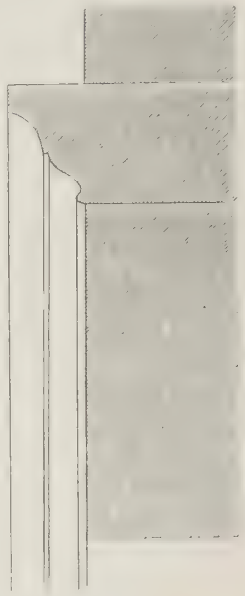


FIG. 100.

rating the decoration from the structure is perhaps the one idea that ties the Italian architecture of the middle ages most closely to that of antiquity, and which distinguishes it the most clearly from the contemporary architecture of France.

In France, during the middle ages, the structure and the form of the edifices were never treated separately; the stones always kept in the building, after they were set, the form given them in the stone yard; and it may be said that trimming and recutting in place were unknown in France from the twelfth to the fifteenth century.

On the contrary, in Italy during the same period, buildings were raised in masses of rude masonry, given, at the most, regular surfaces, where the architects afterwards incrusted the final ornament, or even placed entire façades. The façades of the cathedrals of Sienna, Orvieto, and Bologna are veneers thus placed, either over former façades or on walls prepared to receive a decorative revetment: and, without going to those celebrated edifices, it would perhaps be difficult to find a Gothic church in Pisa, Lucca, or even in the villages of Tuscany, where the decoration as a whole was done at the time of building. The enclosing walls of these buildings were sometimes built of rubble, with projecting bricks for ties, as can still be seen on the uncompleted façade of Bologna, by which were afterwards fastened the more or less richly ornamented outer walls. This reproduction of an ancient method in buildings whose general physiognomy resembles so little that of the Roman monuments affords one of the most curious examples of the variety of aspects that can be presented by the same idea, and of the apparent differences that can be manifested in the application of the same principle.

There are, however, few methods in the art of building that can be carried to their last expression with impunity. It is not for me to say what were the results produced by this separation on the architecture of the Italian Renaissance; but it must be acknowledged that this separation, so advantageous in rapidity and economy, had a regretable influence on the forms of ancient architecture. Becoming accustomed to consider decoration and structure separately, the Romans soon came to regard those things, between which they themselves had made the distinction, as being by their nature independent of each other; they then saw in the architecture of a building only a decorative dress, variable and in a certain degree arbitrary; the separation of the ornament and the construction gave too great freedom to fancy and to imitation, and contributed in precipitating the decadence of art among the Romans.

[1] This is clearly shown in numerous MSS. in the collections of Roman law. In particular see Cod. Theod., Lib. XV., tit. I., l. 19; Lib. VI., tit. IV., l. 13, 29, 30. Cod. Justin. Lib. VIII., tit. XII., l. 5.

I will add that a large number of public edifices were built by the magistrates "*pro ludis*," that is, in place of the festivals or games they were obiiged to give to the people; thus the prodigality that was imposed on those who held public offices was turned to supplying useful work. But one can imagine what haste was necessary in erecting these magnificent presents when one thinks of the short term of office of the principal magistrates of the empire.

See Orelli, Inscrip., 3310. 2540 (?). Cod. Th., Lib. VI., tit. IV., l. 29

Fire-proofing Department.

ORIGIN AND HISTORY OF HOLLOW TILE FIRE-PROOF FLOOR CONSTRUCTION.

BY PETER B. WIGHT.

(Concluded.)

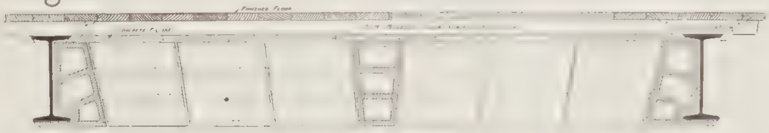
FACTORS OF SAFETY.

NOTE.— The following article was written and in type before the Pittsburg fire occurred and the article commenting on the same was written, and the author sees no reason for changing any of the opinions herein expressed.— P. B. W.

THERE may be a difference in opinion as to what factor of safety should be used for hollow-tile work when it serves any constructive purpose. The manufacturers have not generally taken it into consideration, and *as there have never been any accidents in completed buildings, due to failure in the hollow-tile floor arches*, there does not seem to be any reason for anxiety about it. In Mr. Hill's comments on the tests, published in THE BRICKBUILDER for February, 1895, and in the reports of other engineers, it seems to be taken for granted that the factor of safety is one tenth. At that rate there is not a side-pressure or end-pressure arch in any building used for business or warehouse purposes that is theoretically safe if all the tests are correct. The actual tests of side-pressure arches of the best make have thus far shown that they break at from 500 to 1,000 lbs. per superficial foot, while those for end-pressure arches run up to about 1,700 lbs. I maintain that, if in a number of tests on similar side-pressure experimental arches it should be shown that none of them fail at less than 500 lbs. per foot, it would be perfectly safe to use them where the loads do not exceed 400 lbs. per foot. I know by experience that the average work set in buildings is stronger than the average work in experimental arches, for I have made frequent tests in buildings after construction to demonstrate this. I made not only tests for dead weight on flat arches covered with sand, but for rolling loads and smashing weights on the same, after laying the floors (the wooden floors bearing on the arches), as long ago as 1884, in the Chicago Board of Trade. The rolling load was with a 4,000 lb. safe, which was not only rolled, but dropped on one side several inches. The smashing test was made with cases of dry goods weighing 400 lbs. each, some of which were thrown down from a height of 6 ft. These were 9 in. arches with a span of about 4½ ft. They were not injured in the least, though the wooden floor was badly splintered and broken. In the Natural Gas Company's building at Pittsburgh, 9 in. side pressure arches made by the Wight Fire-proofing Company, set in the building, were tested by the architect up to 1,000 lbs. per superficial foot, and the tests stopped there as he was satisfied with the guarantee. It is, therefore, clear that no such factor of safety has been considered necessary by the makers, as suggested by Mr. Hill. Every contractor knows that the severest tests his work is likely to be subjected to are the accidental ones that occur during the erection of a building. The first test he makes himself when he draws his centering at the earliest possible moment, and it is thus that he insures himself against any carelessness of his workmen. He knows that if there are any defects in the work they will then be developed, and that if any tiles have not been well bedded, they will either fall out or be subjected to the natural pressure of the arch, while before the centering is struck they lie like inert pieces of material on the boards. He knows that every day adds to the strength of the work through the hardening of the mortar, and that this goes on indefinitely.

He often finds clauses in the specification saying that the centering must remain three days, five days, or a week, before it is struck, and his best judgment is often brought in conflict with the architect, whose intentions are all right, but for all that he may be mistaken. Then, when other mechanics are allowed to run over the work, pile up their material or throw down their scaffolding upon it, another set of inevitable tests begins and continues until the building is completed. I have seen enameled bricks piled up solid 6 ft. high on flat arches that did not fail, and no one to protest but the hollow-tile man. I have seen 9 in. side-pressure arches without any webs, covered with 1 in. of Portland cement and 2 ins. of planking, used as a runway through a building, for teams bringing in material, and with safety. These are the tests the contractor is impressed with. Then he has a common-sense idea of what an arch should carry, which does not seem to have been suggested to the engineers. He examines the iron diagram to see what is the strength of the steel floor. It is easy for him to ascertain what would be the weight per foot necessary to deflect the beams to a permanent set, and when he finds that his arches will bear this load he knows that his work will be the last to break when the floor goes down. Anything stronger than this is a superfluity, and when an architect specifies any kind of work between the beams that costs more than enough to accomplish this he is guilty of wasting his client's money. It is strange that this should have been so little considered. And here comes in the question whether or not anything is gained by using end-pressure arches where the side-pressure arch will accomplish all that is required, unless there is any economy in them. On the latter point it is claimed that there is an economy of weight in some sections of tiles when used for the deeper arches. Thus far there has been found no economy in making the walls of hollow tiles less than ½ in. thick, and this is only possible with the best clays. Therefore, the walls of end-pressure tiles cannot be made any less in weight or expense unless the section is so changed as to reduce the average weight per superficial foot. This, I think, has been done with the tile used by the Pioneer Fire-proof Construction Company, of Chicago, and Henry Maurer & Sons, of New York, for illustrations of which the reader can be referred to the advertising columns of THE BRICKBUILDER. But no advantage in weight is possible where rectangular tiles are used. One of the best end-pressure arches of this kind is that of the Terra-cotta Lumber Company, of Chicago, whose illustration is here given (Fig. 23). This arch is made entirely of porous terra-cotta.

Fig 23. Illinois Terra-Cotta Lumber Co's End Pressure Arch.



The skew-backs and the keys are set longitudinal with the beams The intermediate tiles are used on the end-pressure system. In such an arch the material of the skew-backs and key should be thicker than the intermediate tiles, to make up, if possible, for the want of cross webs. The bearing sides are partially inert. But this system shows a better method of setting the skew-backs and putting in the key than if all the tiles were set transversely to the beams. It is a type of all end-pressure arches in which tiles of rectangular section are used, and it is easy to understand from the illustration the variation from it when all the tiles used are on the end-pressure system.

OBSERVATIONS ON THE USE OF HOLLOW-TILE ARCHES.

The end-pressure system has not entirely supplanted the older side-pressure system. It has its advantages when the ultimate weight to be carried on the floors is greater than 400 lbs. per superficial foot. In this I agree with Mr. Hill, and in the main with his conclusions in his paper of July, 1896, which I have no occasion here to repeat. As long as the ratio of effective height to length of span is maintained within one to eight, it is only a question of economy as to which to use. I do not think that the superior strength of the

end-pressure arch is conducive to the reduction of the weight of floors for arches 10 ins. thick or less. Beyond this thickness, the weight of the end-pressure arch may be less than an effective side-pressure arch of the same depth. The cost of setting end-pressure arches is greater than for side-pressure arches.

The advantages of side-pressure arches are still maintained. First, by the greater ease with which they may be constructed, and the less chance of being weakened by inferior workmanship or defective tiles. Second, by the fact that there is a greater distribution of any concentrated load over a greater surface. Under the former may be comprised the more perfect bedding of the skew-back, and the possibility of driving in the key without losing the mortar, and under the latter may be mentioned the breaking of joints. In all side-pressure arches there is a considerable amount of inert material, but this is inevitable on account of the necessary process of manufacture.

The main defect in the end-pressure system is that the courses do not break joints. This has never yet been overcome, the only reliance being on the mortar joints and friction of surfaces, which depends upon the quality of mortar used. There is a way, however, to overcome this objection. Another is in the difficulty in making good joints between the voussoirs, involving always a great waste of mortar. The slight warping of the tiles in process of manufacture throws their abutting edges out of line, and on thin walled tiles this is of serious import. A much better joint can be had with porous than with hard tile, because the material is thicker, and for this reason the porous material is superior for end pressure arches. The greatest difficulty in getting a joint is at the key; for if it fits loose, the joint may run out before it sets, and if it is tight, the joint may be rubbed out in forcing it down. A good bed for a key can only be obtained by "slabbing" the ends of the interior voussoirs with thin pieces of tile before forcing down the key, having allowed for this in ordering the key. Another danger in arches where all the tiles are transverse to the beams is in the breaking off of the protecting bottom of the skew-back, or its cracking where it bears against the bottom flange of the beam; Mr. Hill's tests demonstrated this.

I agree with Mr. Hill that where the protection of the beam is by a projection from the skew-back on each side in any form of flat arch, it leads to defective construction and weakening of the arch. A separate soffit tile corrects this. My own form of soffit tile, which was the first ever used, passed around the flanges of the beam, and the skew-backs were bedded on this and the top of the flange and against web of the beam by one operation. (See Fig. 18, May BRICKBUILDER.) The abutting arches on both sides of the beam were also thrusting against the soffit tile. For this reason I have always maintained that in such constructions the effective depth of the arch was the whole depth of the tile, and this has always been borne out by comparisons between tests on experimental arches, where the soffit tile did not count for anything, and those set in buildings, which have always been in favor of the latter. In such cases two adjacent arches thrust against each other at the center of the soffit tile, the weight of the arch and floor being suspended from the lower flanges of the beam. I will therefore commend it to general use, as the invention is free for any one to use. Besides this, it has a greater advantage in setting. The soffit tiles are set dry on the centering, which when screwed up comes to a true line, while if the skew-backs run under the beams they are set before the centering is screwed up, and if screwed up before the mortar is hard, the bed of the tile on the beam flange is disturbed, and the arch is a defective one as soon as the centering is loosened.

A great improvement in the manufacture of hollow tiles was made after it became customary to make them in vertical sewer-pipe presses. This was first done for the Chicago and Western market, and soon after the example was followed by all the manufacturers in the Central States. Before this all the manufacturers in New Jersey used horizontal presses. The great advantage of the sewer-pipe press is its greater power, which by giving greater pressure to the wet clay makes it possible to reduce the walls, increase the strength, and consequently reduce the weight. This weight reduction was one of the first improvements that made it possible to erect high buildings on the compressible clay of Chicago, but has scarcely been recognized in the many treatises on high buildings that have appeared.

Notwithstanding many other ingenious and meritorious inventions for fire-resisting floor construction, many of which have the only merit of being incombustible, I believe that clay hollow-tile floor arches have come to stay for a long time yet, and that good burned clay will always be the best fire-proof building material. There will continue to be bad work of this kind, however, as long as architects are not discriminating in the quality of clay that enters into the material. Good concrete, which comes next in value, can only be used where bricks formerly were, and where the question of weight is not an important factor. There never will be any economy in using metal to reinforce tile construction, except to resist lateral thrusts, for the tiles can always do their work in compression. The only possible improvement I can see in floor construction with tiles may come when long tiles can be burned as cheaply as short ones, and can be used as lintels between beams. This was the dream of Mr. Scofield many years ago. I have always believed, and do so still, that in mechanics the flat hollow-tile arch with parallel top and bottom is nothing but a beam with confined ends, and that it makes little difference what direction the joints have, provided they are of good mortar and well compressed. There are very few scientific works that have given formulæ for constructions under these conditions. For the information of those who may be disposed to investigate farther, I will refer to a book entitled "Moseley's Mechanical Principles of Engineering and Architecture," with additions by D. H. Mahan, LL. D., published by the old firm of Wiley & Halsted, New York, 1856, pages 402 and 403.

With regard to the direction of the joints, I could never see any advantage in radial joints between voussoirs, which are so generally specified by architects, and which for that reason most manufacturers use. They complicate the work at every point from manufacture to setting, and increase the cost of the latter. In the Denver tests on side-pressure flat arches it is not generally known that as between two hard tile arches the one that broke at 651 lbs. per ft. had radial joints, and that which broke at 1,000 lbs. per ft. had parallel joints from skew-back to key. No record is made or comment given in Mr. Hill's reports of experiments, or, in fact, in any of the published tests, as to whether the arches were of one kind or another, but the illustrations show that the side-pressure tiles in Mr. Hill's tests had parallel joints.

An advantage of hollow tiles for floors which no other system seems likely to overcome is that at one operation it provides a ceiling and a floor, and in the shortest possible space of time. It is all dry in a few days, and does not hinder the rapid completion of the building and its delivery in good condition. It has another advantage in the fact that the arches can be made of any depth up to about 15 ins., and thus fill the whole space between the beams, reducing the concrete filling on top to a minimum, and thus reducing the weight of floors, and in some cases the cost of the work. For fire-proof qualities it requires no further commendation, though for this, as between good hard and good porous tile, I prefer the latter.

In this review of the condition of the art it is not intended to be implied that there are not other and meritorious systems of floor construction with burned clay that are of great value. The intention has been to confine the treatment of the subject to floor constructions in connection with steel beams. Already several systems have been in use which have greatly reduced the use of steel in fire-proof buildings, and they would be proper subjects for another treatise. But the present low price of steel has been such a strong argument for its continued use, that there does not seem any prospect of its ceasing to be the most favorable material to resist transverse strains for a long time to come.

Mortar and Concrete.

LIME, HYDRAULIC CEMENT, MORTAR, AND CONCRETE. IV.

BY CLIFFORD RICHARDSON.

CEMENT.

The word from which we have derived our name cement was originally applied only to certain additions which were made to lime mortar to enable it to harden under water, such as the puzzolana used by the Romans and trass. Later this designation was used for all the binding materials which furnished a mortar which hardens under water and so has extended to our natural and Portland cements. To avoid confusion all these materials are now classed as Hydraulic Agents, Hydraulic Limes, Slag Cements, Natural Cements, and Portland Cements.

HYDRAULIC AGENTS.

Hydraulic agents do not possess the property of setting or forming a mortar by themselves but they offer silica and clay to the lime of ordinary mortar in a form which permits combination between the two, and a slow hardening. They are of both natural and artificial origin. The natural form is from volcanic sources, such as the puzzolana of Italy, and the trass of the Rhine Valley. We have no such deposits available in this country except in the far West. The artificial form includes slıgs, burnt clay and shale, ashes, silicate of soda, and, in fact, any inorganic material which contains clay and silica in the form soluble in acids, that is to say, available for combination with lime in the presence of water. There is a plenty of such material in this country but it is rarely, if ever, used, owing to the cheapness of our natural cements.

HYDRAULIC LIME.

We have already seen that, as the amount of impurities of a clayey nature increase in ordinary quicklime, it takes on hydraulic properties. As long as this amount is not too large to permit slaking, although slowly, the lime is known as being hydraulic.

Hydraulic limes have had extensive use in England early in the century but have never been of the same importance here, although they were imported from France and England before the days of the development of our natural cements. When used they are not distinguished from poor quicklimes, and, of course, are never substituted for the true cements in hydraulic work.

Hydraulic limes with but a small proportion of silicates, 5 to 15 per cent., harden under water in from eight to twenty days, but with larger amount in from one to four. There is no very sharp line between poor cements and hydraulic limes. They usually contain less than 20 per cent. of silica and silicates.

Dolomitic limestones, when burnt at a temperature sufficiently low to expel the carbonic acid from the magnesian carbonate, but not from the lime, have hydraulic properties.

Slag cements will be considered in another chapter.

NATURAL HYDRAULIC CEMENT.

Toward the end of the eighteenth century it was discovered in England that certain limestones, when burned, gave a lime which would not slake, but, when ground and mixed with water, furnished a mortar which would harden under water. A similar cement was also prepared from the septaria or concretions found in the London clay. An examination showed that the limestones and septaria which furnished such cements would not dissolve entirely in acids but left behind a residue of clay. It was evident, therefore, that to the presence of the clay the resulting cement owed its hydraulic properties. Such cements were largely prepared and took the place of hydraulic agents and hydraulic limes, and from their resemblance, in color and results to the mortar prepared with the former, were called Roman cements, a name never used in this country where we hear only of natural cements.

Extent of the Industry. — The importance of natural hydraulic cement in the United States is attributable to the wide extent of the deposits of hydraulic limestone which are suitable for its manufacture. Such stone is found, to a greater or less degree, in a majority of the States, especially along the mountains of the Atlantic States, and is well scattered through the country lying along the Great Lakes and in the West. Cement works are found to-day in New York, Pennsylvania, Maryland, Virginia, West Virginia, Georgia, Ohio, Illinois, Indiana, Kentucky, Wisconsin, Minnesota, Kansas, Texas, Utah, and New Mexico. According to the United States Geological Survey there were 68 plants in 1895 producing 7,741,077 barrels of natural cement, worth about $3,895,424. More than half of this was made in New York; 3,939,727 barrels, and about 1,703,000 in the Louisville district, the next producers in quantity being Pennsylvania, Wisconsin, Illinois, and the Maryland and Virginia district with about 600,000, 476,000, 490,000, and 242,000 barrels. Ulster County, N. Y., where the well-known Rosendale brands are burned, and where the first natural cement in this country was made, alone put over three millions of barrels on the market in 1895, valued at half of the entire product of the year. The United States exceeds all other countries of the world in the quantity of natural cement which it manufactures.

Hydraulic Limestones. — Natural cements can be made from limestones which have a very varied admixture of silica, clay, and magnesia, and considerable differences in physical properties. For each locality, where cement is manufactured, differences in composition will be found, as appears from the following analyses: —

COMPOSITION OF HYDRAULIC LIMESTONES USED FOR WELL-KNOWN BRANDS OF NATURAL CEMENTS.

ORIGINAL ANALYSES.

	1 New York Rosendale	2 New York Akron	3 Penn. Lehigh Valley	4 Maryland Roundtop	5 Maryland Antietam	6 Maryland Cumberland & Potomac	7 Illinois	8 Kansas Ft. Scott
Calcium Oxide CaO	25.80	19 93	29 94	35.76	23 72	25.54	32.85	35.00
Magnesium Oxide MgO	10.09	9.17	1.55	2.18	15.64	1.10	8.45	3.50
Carbonic Acid CO_2 and water . .	30.93	25.90	26.30	31.74	34.82	24.40	34.12	33.00
Silica SiO_2 . . .	21.41	33.80	27.77	19.81	15 97	28.72	17.01	21.80
Alumina Al_2O_3		3 96		7.35		12.28	3 35	3 70
Alumina and Iron Oxide together	10.09		14.29		7.59			
Iron Oxide Fe_2O_3		.88		2 41		5 72	2.39	3.10
Sulphuric Acid SO_3	.66	.50	——	——	.71	1.53	1.81	——
Total Carbonates .	67.26	54.86	56.72	68.44	75.20	46.13	74.15	65.76
Insoluble in Acid .	29.21	35.01	40.15	27.25	20.15	47.72	22.06	23.95

	Carbonate of Lime	Carbonate of Magnesia	Total Carbonates	Alumina and Iron Oxides	Silica	Insoluble
Highest	63.75	32.84	75.20	17.50	33.80	47.72
Lowest	35.59	2.31	54.86	4.84	15.73	20.15

The most distinctive feature in the composition of hydraulic limestones, and one which enables them to be at once divided into two classes, is a marked difference in the amount of carbonate of magnesia which they contain. In the one class it is small, not exceeding 3 or 4 per cent; in the other from 15 to 35 per cent. is found. We have, therefore, two kinds of natural cements, lime and magnesian. With a few exceptions the hydraulic limestones of this country, used for making natural cement, are magnesian. In the Lehigh Valley the stone is not magnesian, and the same is the case in the upper Potomac Valley. Some of the deposits of the West are also nearly straight limestone. Considering their source the greater portion of natural cements, probably over 90 per cent., appear to be made from magnesian limestone. The rock from which the various Rosendale and Louisville cements are made, which alone make up a large part of our product, contains from 15 to 25 per cent. of magnesian carbonate.

The amount of the two carbonates in the limestones is very variable, reaching from 54 to 75 per cent. The silicates and silica may be present in larger or smaller amount, 20 to 47 per cent., and there are similar variations in the relation of silica to the bases, alumina and iron. In many cases there is much free silica with but a small amount of clay, as in the case of the limestone from Akron, N. Y.

The other and minor elements also show their peculiar but less important changes. In spite of these variations in composition natural cements are made from all these rocks.

Of course the properties of the resulting cements are very different.

Variation in the Composition of Rock in one Locality. — In addition to the variations in the composition of hydraulic limestone in different parts of the country a striking difference is also found in the strata in any one locality, or even in one quarry. There is generally no difficulty in distinguishing at a mere glance peculiarities of color and other physical properties which serve to mark the different strata and separate them. A chemical analysis is then required to determine the variations in composition or they may be tested by burning small amounts of the rock in an ordinary fire, crucible, or experimental kiln, or better, by both methods.

In case a chemical analysis is made it should be carried out according to the methods given in "Blair's Analyses of Iron and Steel," third edition.

In two cement rock quarries, one in Maryland and one in the West, strata are exposed which are typical of the variations in composition which have been mentioned.

COMPOSITION OF THE STRATA IN A WESTERN CEMENT QUARRY.

1. 4 ins. Limestone.
2. 6 ins. Limestone.
3. 20 ins. Bituminous shale.
4. 36 ins. Clay.
5. 48 ins. Cement rock.
6. 30 ins. Slate or shale.
7. 14 ins. Coal.
8. 30 ins. Clay, very hard.

	1	2	3	4	5	6	8
Loss on ignition. Carbonic acid, water and organic matter	40.2	43.0	32.90	7.2	33.0	6.50	6.3
Lime, CaO	48.0	50.1	.30	.5	35.0	6.70	.4
Magnesia, MgO	2.0	2.8	2.39	2.0	3.5	2.57	1.08
Alumina, Al_2O_3	1.0	1.1	17.00	19.1	3.7	13.00	13.6
Iron oxide, Fe_2O_3	1.8	1.0	3.90	4.4	3.1	3.30	2.4
Silica, SiO_2	6.7	2.6	36.30	61.8	21.8	65.60	72.9
Insoluble in acid	7.5	3.5			24.3		
Total carbonates	89.9	93.6			69.9		

COMPOSITION OF FIVE STRATA OF CEMENT ROCK IN A MARYLAND CEMENT QUARRY.

No. 1. Top. Not in use, below the slates and pure limestones.
No. 2. Cement rock.
No. 3. Not in use.
No. 4. Cement rock.
No. 5. Not in use.

Loss on ignition. Carbonic acid, water, and organic matter	33.93	31.74	33.01	24.55	28.08
Lime, CaO	28.25	35.76	38.05	31.02	33.80
Magnesia, MgO	9.41	2.18	1.84	3.39	1.17
Alumina, Al_2O_3	5.25	7.33	5.58	4.17	5.43
Iron oxide, Fe_2O_3	7.07	2.41	3.88	8.29	2.40
Silica, SiO_2	15.71	19.81	16.7	26.52	24.62
Sulphuric acid, SO_3		.16		.19	
Insoluble in acid	28.13	29.66	26.05	29.10	33.51
Total carbonates	70.21	68.44	71.63	62.52	54.45
Magnesian carbonate	19.76	4.58	3.86	7.12	2.46

It appears that the strata of hydraulic limestone may be associated with others of purer limestone, of slate or shale, and in the West of clay and of coal. The presence of strata of slate and the purer forms of limestone are common to almost all cement rock quarries, whereas the clay and coal are peculiar to the geological formations of the West. The Maryland quarry illustrates how great the variations in composition may be in five well-defined strata, all of which are of hydraulic character. The upper bed in this quarry holds nearly 20 per cent. of magnesian carbonate, while the rest are comparatively free from it. The total carbonates vary from 54 to 71 per cent. and the silica and silicates from 26 to 33 per cent., with corresponding variations in the per cent. of lime present. In other quarries an even more striking variety of rock is found as will appear later.

There is also one other variation in the composition of hydraulic limestone which must be noticed. In the same stratum, as it is worked or quarried over a large area, differences in composition are found, due to changes in the material laid down at the time of its formation or, to a less degree, by subsequent action of water. Such variations must be guarded against, but they are usually of minor importance in a good quarry.

With deposits of such a diversified nature it is apparent that the manufacture of natural cement can be based on no absolutely uniform practise. For each quarry and each stratum its own peculiar methods of working must be found.

Character of Limestone Suitable for Natural Cement. — The different strata of hydraulic limestones in any quarry are not, therefore, equally suited for making natural cement. Their availability for this purpose has been determined primarily by experiment. By comparison of the results so obtained with the chemical composition of the rocks it has been shown that this is dependent on the amount of silica and silicates which they contain, or their relative proportions, and on the per cent. of magnesia, with some regard also to that of the sulphur compounds and alkalies present. It is also important that the silica should be combined with alumina, that any silica present should not be too coarse grained to unite with lime at the temperature of burning and that the rock should be of great density so that the burning and the product may both be satisfactory.

There are, of course, other substances in such limestones which are of minor or no importance, such as manganese, phosphoric acid, barium, which are present to the extent of but fractions of a per cent. The essential constituents, however, whose relations are to be considered as involving the suitability of the rock for cement making, are silica, silicates, including the alumina and iron oxide, of which they are composed, the carbonates of lime and magnesia and at times of iron, and the alkalies and sulphur compounds. These substances can be divided into those soluble and those insoluble in acids, the former including the carbonates and the latter the silica or sand and the silicates. In a rough way a determination of the relative proportion in which these two classes of substances are present is sufficient to characterize a hydraulic limestone.

A more careful inquiry into the effect of the presence of a larger or smaller amount of each constitutent is necessary, however, in order to understand thoroughly what properties the cement derived from different limestones may be expected to have.

The two great classes of natural cements, distinguished by the presence and absence of magnesia, have, to begin with, entirely different characteristics. The magnesian cements, of which the Rosendale brands are typical representatives, do not heat on mixing with water. They set and acquire strength slowly, but eventually are as strong as the lime cements. They do not resist the action of frost well when first used, and if not carefully proportioned have a tendency to expand a year or more after use. The lime cements, unless carefully made, have a tendency, when made into mortar on the one hand, to heat when too rich in lime and on the other to blow when too rich in silicates or when overburned. They acquire their strength rapidly, having nearly twice as great a tensile strength at from one to twenty-eight days as the magnesian cements. They resist frost better than the latter, but at the age of a year they are often not superior, in fact are, at times, inferior, more crystalline and brittle with a tendency to deteriorate in strength. The perfectly proportioned and carefully made cements of this class are, however, the best natural cements in the world. The Round Top cement of the Potomac Valley is typical of the highest grade of the lime cements, as the numerous Rosendale brands are of the magnesian class.

The Masons' Department.

STRAINS IN ARCHES. II.

BY JOSEPH MARSHALL.

IN all arches of the first class, and in arches of the varieties of the second class, shown by Figs. 5 and 7, there are three distinct forces in operation, but in all other varieties of the second class there are only two. These forces we will, for convenience, name "The Thrust," "The Counterthrust," and "The Counterfort," and under all circumstances, in all classes and varieties of arches, the counterthrust and counterfort, singly or combined, must equal the thrust before the arched structure can be in equilibrio. Of course all these forces are the result of gravitation on the mass of the arch, its load, and its supports.

The thrust is that force which tends to drive apart the supporting piers; the counterthrust is that which tends to draw them nearer, and the counterfort is that which balances the difference between the other two.

If the thrust and counterthrust were of equal intensity — a rare occurrence — then the counterfort were unnecessary. It is then of importance to determine quickly and accurately the relations between the efforts of thrust and counterthrust, and to this purpose we now address ourselves.

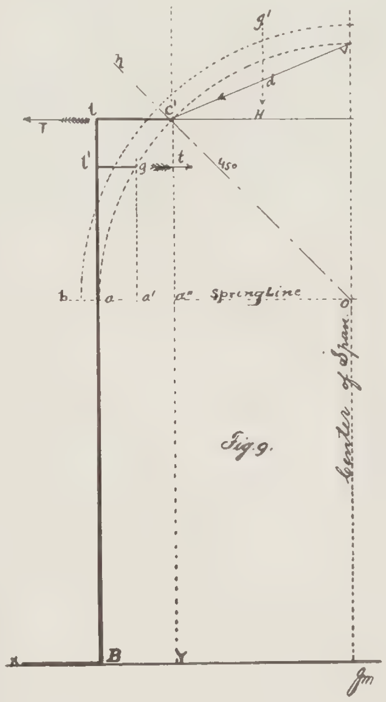
If thrust and counterthrust prevail in an arch — one opposing the other — at what point in the arch do the forces meet? For this must be a neutral point.

To this we answer: The neutral point will always be at the intersection of the arc of the arch by a line drawn at an angle of 45 degs. of elevation from the center, whence the arc is described, and this line and point we shall hereafter designate as the "Neutral" line or point.

It is evident that in a quadrant of a circle (which embraces 90 degs.) having one side parallel to the horizon, and the other perpendicular to it, the 45th deg. is midway between the vertical and horizontal, and that all parts below the 45th deg. stand more nearly vertical than horizontal, while all above that point are more nearly horizontal than vertical; hence, the weight of all parts below the neutral line will be discharged upon the piers with less tendency to disturb them than the weight of the parts above the neutral line, and moreover, the tendency to disturbance, which the arch below the neutral possesses, is exerted in the direction of the extension of that part of the arch, because in that direction it overhangs the gravity center of its support, thereby tending to draw with it in that direction the pier upon which it rests, while all that part of the arch above the neutral line, being suspended between the neutral and vertical lines, tends to force equally in both directions, but being opposed by an *equal* force on the opposite side of the vertical line (the force of the other half of the arch), its whole force is concentrated upon the neutral point, and being impelled by gravity, seeks the line of least resistance.

Referring now to Fig. 9, let us suppose that the vertical line from B to l possesses all the elements of a pier of brick 12 by 12 ins., except rigidity and sectional magnitude. Let the semi-circle in dotted lines from a to v represent the intrados boundary of an arch, the neutral line, $o\ n$ from o (the center whence the arc is described), will intersect it at c', which is the neutral point. We have then the weight of that part of the arch c' to v, and whatever load this may carry, as constituting the thrust and impinging at c'. By the resistance which the lower part offers, the direction of the force is changed to that of least resistance, which would be the horizontal — c' to l — as indicated by the arrow T. Then l to B will become a lever which will be acted on at l by the thrust force; and if this thrust force in pounds be multiplied by the length in feet of the lever $l\ B$, the sum will indicate the pound force at B if not opposed by any other force. This would be the case if we consider c' to v as constituting a *segment* arch, having a half span $o\ a''$ mounted on a pier, the inner line of which coincides with the line $c'\ Y$. But in the example in hand, we have the arch a to c' overhanging its pier from a to a'', and having the mean of its force above the center of its overhanging distance, as $g\ a'$, which tends to draw the pier in the direction of the arrow t. The pound force at g multiplied by the foot length of the lever $l'\ B$ will, in its sum, represent the counterthrust at B. We must here remember that the pound force at g will, in its efficiency, be one half the weight of the arch from a to c' and the load it bears. The counterthrust force at B will always be less than the thrust force for this form of arch and *all* others, except pointed arches above the equilateral, *i. e.*, pointed arches, the radius of which is *greater* than the span.

When the counterthrust is less than the thrust, subtract the less from the greater, and the difference will be the excess of the thrust force at B — supposed to be the base of the supporting pier. This excess must be counterpoised in some way by the counterfort. To do this, we must provide a gravity force conceived to be acting upon horizontal arms rigidly attached to the lever $l\ B$, so that it becomes a bent lever. This gravity force is derived from the weight of *all* of the half arch, the weight of the supporting pier, and more weight if necessary. We will then divide the weight of the half arch and pier — taken in pounds — into the excess of the thrust force in pounds, and the quotient will be the length in feet of the lever B to X which would be necessary if no more weight were added to the counterpoise. The lever arm B to x,



having the weight concentrated at the end B, then becomes the counterfort and balances the thrust — always assuming the pier is sufficiently rigid to sustain the load.

For the counterpoising gravity, then, we have: weight of arch, weight of pier, and weight of counterfort. It will be observed that it does not matter whether the counterpoising weight be placed on the lever $B\ x$ or the lever $l\ c'$, except that the lever $l\ c'$ is always limited by the arc of the arch, while the lever $B\ x$ is considered unlimited as to length; also, the lever arm $l\ c'$ will wholly disappear in arches of the second class, of the varieties shown by Figs. 6 and 8. In such arches, counterthrust is also absent. It is also evident that a part of the counterpoise may be applied to each of the lever arms $B\ x$ and $l\ c'$.

To test the foregoing reasonings as well as to better demonstrate the procedure, let us suppose Fig. 9 to be at a scale of ⅛ in. to the foot. It will then represent one half an arch 42 ft. span, mounted on piers 30 ft. to the spring. For convenience we will suppose the arch

and pier 1 ft. by 1 ft. sectional area, and weighing 120 lbs. to the cubic foot. Not pretending to extreme niceties, we measure the intrados of the arch *a* to *v* for length, and this we know to be 33 ft.; each lineal foot we will call a cubic foot. Now we know that there is 16½ cu. ft. above the neutral line, and 16½ cu. ft. below it. Then we have: —

Upper part of arch.		Lower part of arch.	
16½ cu. ft. × 120 lbs. =	1,980 lbs.	16½ cu. ft. × 120 lbs. =	1,980 lbs.
× lever *l B* in feet	44¾	÷ 2 (for half)	990
Thrust force at *B*	88,605 lbs.	× lever *l' B*	40¾
		Counterthrust at *B*	40,342

Hence, thrust	88,605 lbs.
Counterthrust	40,342 „
Excess thrust	48,263 „

This excess of thrust must be counterpoised, we will suppose, by the weight of the arch and pier, thus: —

Weight of arch	3,960 lbs.
„ „ pier	3,600 „

Excess of thrust lbs.

Total counterpoise w't. lbs. 7,560)48,263(6 ft.
45,360

2,903
× 12 for ins.

34,836(4½ ins.
30,240

$\frac{3,596}{7,560}$ about ½ in.

This would indicate that the lever arm from *B* to *x* would require to be 6 ft. 4½ ins. to just balance the forces of the arch if no more weight was anywhere added — the quality of rigidity in the lever arm *B x* being the agency through which the excess of thrust force is expended.

If the arm *B x* must be 6 ft. 4½ ins., what length must a similar lever be at the springing line of the arch? We have for that calculation the same weights for the two parts of the arch, but these weights operate through much shorter leverage. Then we have: —

Upper part of arch.		Lower part of arch.	
Weight	1,980 lbs.	Weight of arch	1,980 lbs.
× lever	14¾ ft.	÷ 2 (for half)	990
Thrust	29,205 lbs.	× lever	10¾
			10,642 lbs.

Excess of thrust 18,563 lbs.
÷ weight of half arch 3,960)15,840(4 ft.

2,723
12

32,676(8¼ ins.
31,680

$\frac{996}{3,960}$ — ¼

Thus, at the springing line we would require a pier (or lever arm) 4 ft. 8¼ ins. horizontal extension. This would seem to confirm our statement in the first chapter — that an arch could be overturned, even if the piers were absolutely immovable below the spring line; but the arches which may thus be destroyed are those only which exert a counterthrust, because it is only in this kind of arch that the thrust occurs above the springing line. Arches which have their springing line and point of thrust coincident upon their supporting piers may, indeed, fail, or be destroyed without final rupture of their piers, but only in a manner quite different from that pointed out above.

CRACKS IN TERRA-COTTA.

MANUFACTURERS of terra-cotta have a real grievance against builders and architects, on the score of the material not being properly dealt with by them. It would not be difficult to point to several large buildings in terra-cotta, the walls of which, especially in basements, are cracked from top to bottom. Speaking the other day to an architect who was very fond of terra-cotta, and had used it in many important buildings, we asked him why he did not now favor the material so much as formerly. His answer was not of the stereotyped kind relating to lateness of delivery and delays; but he indicated that he had been disappointed by the cracking of the material when subjected to much weight in heavy walls, though these cracks did not make their appearance until after the building had been up some time. No doubt many of the faults under such circumstances arise from settlement of the foundation; but we feel perfectly convinced that they would be far less prevalent and not be so noticeable if more attention were paid to setting and filling in building up the walls — and that is where the makers' chief grievance comes in. It seems to us that many of the large users regard terra-cotta for walls as a species of veneer; which does an injustice to the material. There are powerful reasons for not using terra-cotta in large solid blocks, on account of warping and twisting in burning and the like. And makers certainly have a right to insist on the filling being properly done, so as to render the blocks solid in the wall; it is not that the terra-cotta is at fault, but the builders. — *The British Brickbuilder.*

FRESH CEMENT, TO PAINT OVER.

A CONTRIBUTOR to *Painting and Decorating* recommends that the walls be washed with dilute sulphuric acid several days before painting. This will change the surplus caustic lime to sulphate of lime or gypsum. The acid should be about one half chamber acid and one half water, but if quick action is wanted 66 per cent. acid will answer. This should be repeated before painting, and a coat of raw linseed oil flowed on freely should be given for the first coat. While this cannot be always guaranteed as effectual for making the paint hold, it is the best method our correspondent has heard of for the purpose, and is worth trying when it is absolutely necessary to paint over fresh cement.— *Exchange.*

"POINTING."

AT this season of the year house fronts are commonly cleaned down, brickwork is "pointed," and with the assistance of paint the external aspect of the dwelling is changed. If people are silly enough to paint brickwork, let them do so; but there is more sense in "pointing it." What we desire to criticize in this "note" is the manner in which the pointing is done. The builder takes no trouble whatever over the bricks; he chips away the sharp, clean-cut edges, and scratches the mortar out. Then he fills up the holes made with mortar, and attempts to "restore" the sharp edges of the bricks by a compromise between a "trowel line" and a black streak. The chipped edges of the brick are hopelessly plastered over in the process, and never afterwards will the building front look like a good piece of brickwork. Whatever may be the excuses for pointing,— and they are many in populous, smoky districts,— there can be none for ruthlessly destroying the effect of a good piece of work. This morning we have just seen a really handsome brick front in process of mutilation in this fashion. The clipping and scraping having been duly carried out, a colored mortar — yellow, like the bricks — has been thrown in, and the clippings hidden by the leveling of the whole by the trowel. Then the inevitable "black streak" is performed, and the front looks as though it had been ruled into squares and irregular oblongs. And the "builder, decorator, and sanitary engineer" is so proud of his ghastly work that he has actually had the impudence to erect a board in the front garden giving his name and address! If "pointing" is to be done, let it be done carefully and reverently, and not as though the building were to form part of an ephemeral exhibition or raree-show.— *The British Brickbuilder.*

Recent Brick and Terra-Cotta Work in American Cities, and Manufacturers' Department.

NEW YORK.— The quiet season has begun in New York as well as in most of the large cities, as chronicled in the daily press. It seems inevitable, at this time of year, that there should be a dearth of large operations in building projects. The rush, not as powerful as usual, ceased about May 1, and speculators and investors are quietly resting now until time to search for "new worlds to conquer." Preliminary sketches are now in progress for several important buildings designed to be ready for occupancy in '98, but most of the activity this summer will be in the preparation of plans for small buildings and residences. Some of the most important items of news follow.

TERRA-COTTA FIGURE, 10 FT. HIGH, ON GABLE, AMERICAN BAPTIST PUBLISHING SOCIETY BUILDING, PHILADELPHIA, PA.
Frank Miles Day & Bro., Architects.
Executed by the Conkling-Armstrong Terra-Cotta Company.

The disastrous fire on Ellis Island, which fortunately was confined to destruction of property only, will necessitate the entire rebuilding of the island, which has been used for many years as the landing place and headquarters for emigrants from foreign countries. The buildings have always been considered unsafe and unsubstantial, and although frequent complaints had been made to the authorities at Washington, nothing was done, until now some action is inevitable. The President has suggested that an appropriation of $600,000 be made, and Col. John L. Smithmeyer, of Washington, has been appointed Superintendent of Construction for the erection of the proposed buildings. The new buildings will be fire-proof, of brick or iron, and so constructed that the several parts can be cut off from each other by fire walls and steel doors.

Clinton & Russell, architects, are preparing plans for a fifteen-story brick and stone office building, to be built at Nos. 35 to 39 Broadway, for the Hemenway estate.

Ernest Flagg, architect, is preparing plans for a building to be erected on the north side of 36th Street, near Broadway.

James B. Baker, architect, is preparing plans for an office building to be erected corner of Fifth Avenue and 45th Street, for T. T. Tower.

W. J. Dilthey, architect, has completed plans for "The Renwick" store and loft building, which will cost $100,000. It will be located corner of University Place and 10th Street, and will be eight stories, all fire-proof.

Harney & Purdy, architects, are making sketches for a Hospital and Home for Colored People, to be erected on Concord and Wales Avenues, and to cost $100,000. It will be a four-story brick and stone building.

Lamb & Rich, architects, are preparing plans for a Baptist Church to be built corner Convent Avenue and 145th Street. Cost, $75,000.

C. P. H. Gilbert, architect, has planned an hotel, to cost $200,000, for the Imperial Realty Company. It will be a nine-story brick building.

TERRA-COTTA BELL TOWER, ST. JOHN'S CHURCH, JOHNSTOWN, PA.
Beezer Brothers, Architects.
Terra-cotta made by the Standard Terra-Cotta Company.

CHICAGO.— Building news continues to be depressing. A late issue of the Chicago *Economist* gives a column headed "Desperation of the Architects," in which the condition of the profession is declared to be worse than the general results of business stagnation. The evils of cutting prices is alluded to, and particular stress is laid on the disastrous competition between architects and their own draughtsmen, who work at night and have no office expenses. We may hope that some of the evils of the illegitimate practise of architecture will be done away with as a result of the law passed lately by the Illinois legislature. Under the provisions of this statute, any one who desires to practise architecture must

TERRA-COTTA CAPITAL, STEWART BUILDING, CHICAGO.
D. H. Burnham & Co., Architects.
Executed by the Northwestern Terra-Cotta Company.

VANDERGRIFT RESIDENCE, PITTSBURGH, PA.
Alden & Harlow, Architects.
Bricks manufactured by Harbison & Walker.

pass an examination and pay twenty-five dollars for his license, and an annual fee thereafter of five dollars. Established architects are not required to take the examination. Every individual member of a firm must take out a license. Record must be made in every county where an architect practises. The bill seems to have passed with little change from the form in which it was recommended by the Institute of Architects. A casual reading gives the impression that the clause which allows a contractor to be his own architect may afford a means of evading the law just where, for the sake of good architecture, it ought to be most effective.

The make-up of the examining board, the conditions for revocation of licenses, etc., are details of interest to the profession, which looks at the bad business, worse architecture, and some of the so-called members of the profession who bring disgrace upon it, and *hopes* that the new law will accomplish something.

The most important item this month is a ten-story office building, by Holabird & Roche, which is to be erected this summer at Clark and Harrison Streets, to cost $200,000. This location is at present the south side limit of high office buildings.

N. S. Patton, architect for the Board of Education, has several schools on hand.

S. S. Beman is taking bids on a hotel to be built in South Bend, Ind.

Plans have been completed by H. L. Ottenheimer for a four-story apartment building, to cost $100,000.

Bishop & Colcord have a $75,000 building of the same character under way.

Robert S. Smith has designed two important apartment buildings.

Among good residences may be named one at $75,000, designed by Richard E. Schmidt. Architect Fritz Foltz is designing one to cost $25,000.

BUFFALO.—Last month ended with far brighter prospects for the building trade than have been seen for a long time. On every hand seems to be the opinion that, with the settlement of the tariff, this city will begin, if not to boom, at any rate to be very busy.

There are several large buildings to be started very soon, chief among which may be cited the new building for the Buffalo Savings Bank. It is to be erected on the corner of Main and Huron Streets. The site cost $260,000. The building is to be built from designs obtained in competition. A week ago the following architects were invited to submit sketches: C. W. Eidlitz and R. W. Gibson, of New York, and Green & Wicks, A. Essenwein, Lansing & Belerl, Geo. Cary, E. A. Kent, Beebe & Son, Bethune & Fuchs, and C. K. Porter, of this city.

The committee announced that $250 would be paid to each competitor, and reserves the right to reject any and all plans, or adopt any which meets with their approval.

The New York architects have notified the secretary that they will not enter on such terms, but have sent a circular issued by a number of architects whereby they agree to prepare plans under conditions not approved of by the bank authorities.

No reply has yet been made, but the prospects are that the local architects only will compete. The building is to cost $300,000, and is to compare favorably with any buildings in the neighborhood. The directors wish to obtain one of the handsomest individual banking houses in the county.

The former owner of the property has bought from the Catholic Institute a block on Main Street and intends to build a fine structure there. As a consequence of this, the Catholic Institute intends to go on with their Institute on the corner of Main and Virginia Streets, and Messrs. Metzger & Greenfield have received the order for plans for the same. The idea is to have a building about 60 ft. high, three stories, with a frontage on Main of 98 ft., and to be built in the style of Italian Renaissance, with an imposing façade. Terra-cotta is expected to enter largely into the composition of both these buildings.

A large apartment house is to be built on Franklin Street, near

CHAPEL, WASHINGTON STREET, BOSTON.
Rotch & Tilden, Architects.

TERRA-COTTA WINDOW LINTEL, OSTERWEIS BUILDING, NEW HAVEN, CONN.
Brunner & Tryon, Architects.
Executed by New Jersey Terra-Cotta Company.

Allen. The plans have been drawn out of town and everything has been conducted with great secrecy, but the fact has leaked out. It is to be an elaborate structure, and is to far exceed in finish and convenience any building of the kind erected so far in this city.

There has been some little excitement over letting the contract for fire-proofing the new school No. 12. One of the fire-proofing companies using hollow brick complains that the specifications have been drawn to suit the Expanded Metal Fire-proofing Company, thereby preventing any other class of fire-proofing from having an equal chance to bid on the work. Nothing has been done in this case, but a proposition has been made to allow all fire-proofing companies to submit estimates for the ironwork necessary for their individual systems.

TERRA-COTTA PANEL, BUILDING WAVERLY PLACE AND GREENE STREETS, NEW YORK CITY.
Robert Maynicke, Architect.
Executed by Excelsior Terra-Cotta Company.

PITTSBURGH. — Some few new buildings are maturing on paper, among which is a new school building for the third ward, Allegheny, for which Architect F. C. Sauer is preparing the plans. It is to cost about $200,000.

The North Braddock School Board have decided to erect a new school building at a cost of $20,000.

Architects Shaw & Bailey are preparing plans for a three-story brick schoolhouse for Warren, Penn., to cost about $30,000.

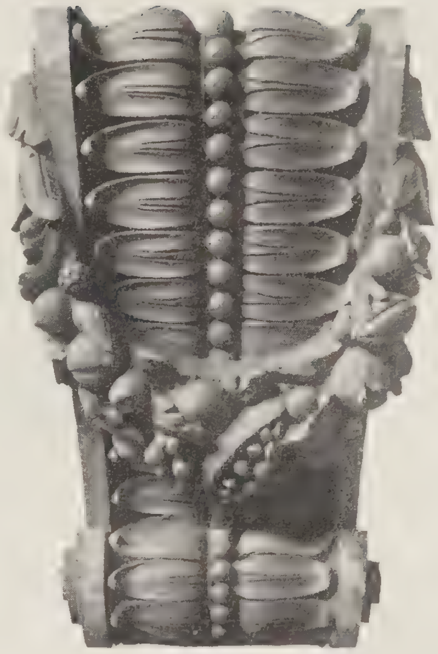
Architects Alden & Harlow have been selected to prepare plans for the new industrial school building for the second ward, Homestead, to be erected by Mr. C. M. Schwab, president of the Carnegie Steel Company. It will be two stories, of brick, and contain eight rooms, to cost $25,000.

The same architects have prepared plans for a four-story brick warehouse to be erected on Liberty Street, for John Way, Jr.

Local architects have entered competitive designs for a new library building to be erected by Washington and Jefferson College, at Washington, Penn., at a cost of $60,000.

The Fifth Avenue Baptist congregation have accepted plans for a new $10,000 church on the site of the old chapel.

Architect J. P. Brennan has prepared plans for an industrial school for the St. Paul's Orphan Asylum, Tannehill Street, to be three stories, of brick, and to cost $15,000.



TERRA-COTTA KEY, BUILDING WAVERLY PLACE AND GREENE STREET, NEW YORK CITY.
Robert Maynicke, Architect.
Executed by Excelsior Terra-Cotta Company.

A new Casino will be erected here from plans prepared by Architect J. D. Allen, of Philadelphia, Penn., of steel construction and terra-cotta, to cost $150,000.

ROCHESTER. — Thus far there has been but one important building erected this year — the new extension to the wholesale warehouse of Sibley, Lindsay & Curr, which is about 75 by 150 ft., seven stories high, iron and steel construction, terra-cotta partitions, and floor arches, and cost about $75,000.

The massive foundations for the new Lehigh Valley Railroad Company's new depot are as yet uncompleted. The latter building, when finished, will be one of the handsomest structures in the city, and is the work of Architect J. Foster Warner, as is also the Sibley Building extension.

Architect George T. Otis is about to let contracts for the erection of a four-story building for the Young Women's Christian Asso-

TERRA-COTTA PIER CAP, 15TH STORY, ST. JAMES BUILDING, NEW YORK CITY.
Bruce Price, Architect.
Executed by the Perth Amboy Terra-Cotta Company.

ciation. Building will be about 60 by 85 ft., with a gymnasium wing 30 by 75 ft.; the latter will be fire-proof. Front will be of press-brick, furnished by the New York Hydraulic Press-Brick Company, and trimmed with Indiana limestone, or Vermont marble and terra-cotta; the building complete will cost about $35,000.

The Rochester Steam Laundry Company are erecting a new press-brick front to their four-story building on Court Street, from designs by Fay & Dryer. New York Hydraulic Press-Brick Company furnish the brick, and Excelsior Terra-Cotta Company the terra-cotta.

Architects Kelly & Headley are about to let contracts for the erection of the Wayne County (New York) Court House, which they recently won in competition. Building will be of press-brick trimmed with light-colored stone and terra-cotta.

Architect Claude F. Bragdon, of this city, has taken in a partner, Mr. J. Con Hillman, of Portland, Ore. Messrs. Bragdon & Hillman have prepared plans for a number of buildings to be erected at Despatch, N. Y., ranging in cost from $1,500 cottages to the $30,000 hotel, including a town hall, church, and railway station, the latter being completed and the hotel started; all are of brick and in "colonial style."

BRICK AND TERRA-COTTA FIREPLACE MANTELS.

THERE are no materials which can be used in interior finish about the chimney corner to better effect than brick or terra-cotta, which, when skilfully chosen and arranged, produces soft, harmonious effects not obtainable in any other way.

Architects who have had large experience in the use of such material have learned, however, that the production of special designs is attended not only with such great cost as to be often prohibitive, but that the burning to order of special terra-cotta to the uniform color, size, and nicety required for interior decoration, particularly in the so-called "fire-flashed" colors, is a difficult undertaking, and results in frequent failures, delays, and disappointments.

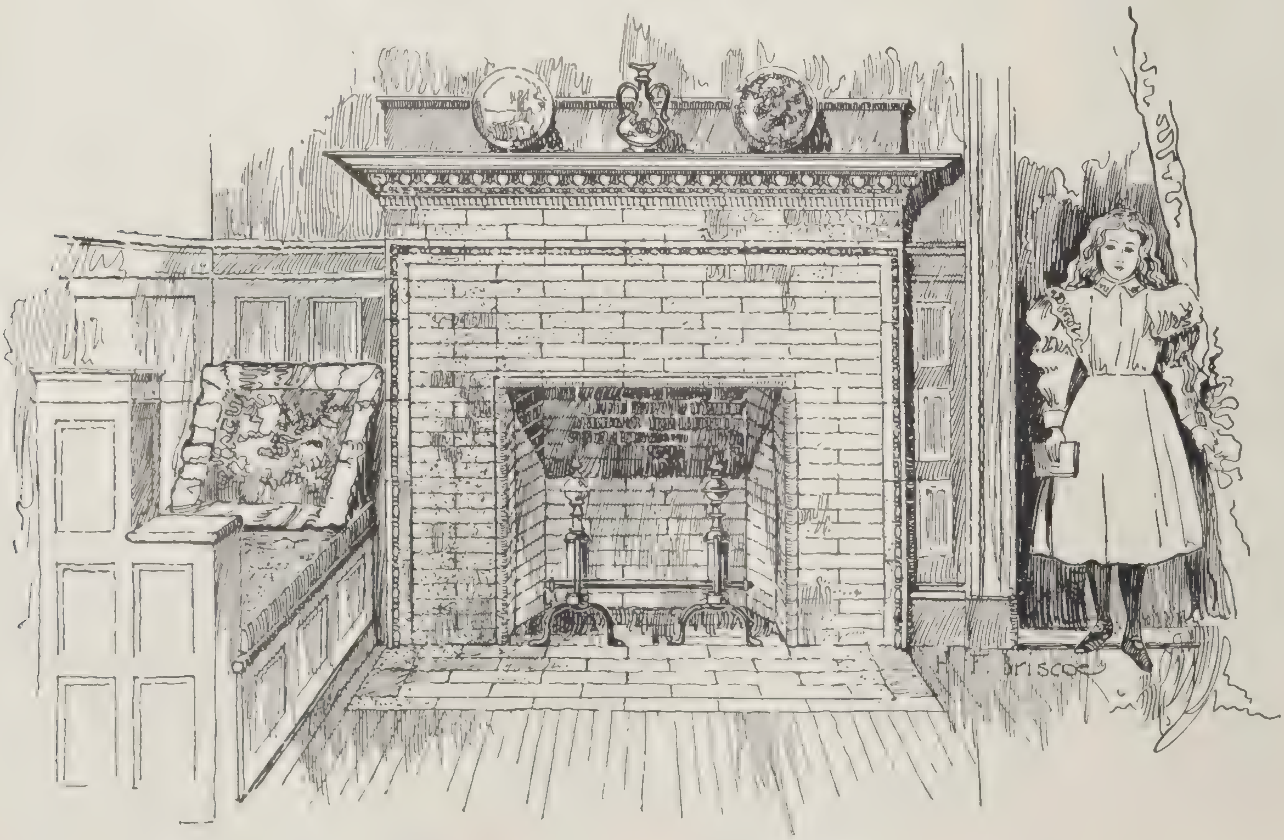
TERRA-COTTA FRIEZE, AMERICAN BAPTIST PUBLISHING SOCIETY BUILDING, PHILADELPHIA.
Frank Miles Day & Brother, Architects.
Executed by Conkling-Armstrong Terra-Cotta Company.

Any concern, therefore, that can offer a line of fireplaces in brick or terra-cotta, producing all the artistic effects of special designs, with the low cost and certainty of delivery attending stock patterns, will certainly make a most valuable contribution to the resources of our architects, and will greatly widen their present scope in the interior finishing of their buildings.

Fiske, Homes & Co., of Boston, have undertaken this task, and how well they have succeeded will be seen from the accompanying cut of one of their smaller designs, by the full-page advertisement shown elsewhere, and the series of drawings which they propose to illustrate in our pages during the coming year.

In their mantels they have adopted a somewhat novel method of handling the ornamentation, which is largely in terra-cotta form instead of molded bricks, thereby producing an artistic style not otherwise obtainable.

They have employed competent designers to first lay out the



BRICK AND TERRA-COTTA FIREPLACE MANTEL.
Designed by J. H. Ritchie. Del. by H. F. Briscoe. Modeled by Tito Conti.
Manufactured by Fiske, Homes & Co.

mantels without reference to the detail of the manufacture, giving them full scope to proportion and arrange them for the production of the finest architectural effects. The modeling has been done entirely by hand in the best classical style, while the pressing of stiff-tempered clay in smooth metal dies gives a nicety of finish much superior to the usual terra-cotta work made in plaster of Paris molds.

The terra-cotta work is all made in standard-sized interchangeable pieces.

In burning these pieces in the kilns, a variety of shades is obtained which are culled with great care, thus enabling an entire mantel to be furnished of a uniform color. This result cannot be accomplished in any other way, particularly in fire-flashed material.

A feature of great importance, which we hope will be appreciated and utilized by architects, is the opportunity afforded them of making designs to suit their own individual tastes as regards the choice and arrangement of ornamentation, by bringing together in any desired combination the standard interchangeable pieces which Fiske, Homes & Co. are now prepared to furnish. This method will give practically all the desirable features of special designs, but with the moderate cost and certainty of delivery already mentioned.

We illustrate above one of their low cost yet artistic designs in which the facing is made of 8 by 1½ in. bricks with beaded jambs, with a delicate bead and reel border, and the cornice of a skilfully modeled egg and dart and dentil design; a wood shelf and backboard are used to give a smooth and finished effect.

This design can be furnished in a variety of colors, and any width of opening from 28 to 48 ins. (varying by 4 in. intervals), the other dimensions being in proper proportion. By this flexibility of dimensions, which can be obtained only by the method adopted in these mantels, the requirements of any particular case can be suited.

OF INTEREST TO ARCHITECT AND MANUFACTURER.

Mr. J. Parker Fiske was admitted to the firm of Fiske, Homes & Co., Boston, on July 1, 1897.

Waldo Brothers have received the contract for furnishing the ornamental terra-cotta for Highland Spring Brewery, Boston.

Negotiations have been closed whereby Meeker, Carter, Booraem & Co. will, in the future, handle the Brooklyn business of O. D. Person, of New York.

Simpson Brothers, Boston, are using Alsen German Portland Cement for platform work at new Newton stations, buying of Waldo Brothers, New England agents.

The F. D. Cummer & Son Company, of Cleveland, Ohio, reports the sale of one of its celebrated dryers to be shipped to St. Petersburgh, Russia, and three to Antwerp, Belgium.

Waldo Brothers are supplying the Atlas brand of American Portland Cement for foundation work for Converse Building, Milk Street, and White Building, Boylston Street, Boston, Winslow & Wetherell, architects, and L. P. Soule & Son, builders.

The American Enameled Brick and Tile Company has closed contract with the board of trustees of the Ohio State University for about fifty thousand enameled brick for use in Townshend Hall Building, of Ohio State University, Columbus, Ohio.

Meeker, Carter, Booraem & Co., of New York City, have opened a branch office in the Arbuckle Building, Brooklyn. In addition to a full line of burnt clay materials of foreign and domestic manufacture, they will carry common bricks, lime, cement, etc. One of the principal reasons for opening this office is to push the sale of paving bricks, manufactured by the Eastern Paving Brick Company. This branch of their business will be in charge of Mr. Paul E. O'Brien.

The Tiffany Enameled Brick Company, Chicago, have closed the following contracts for their brick: Cataract Construction Company Power House, Niagara Falls, McKim, Mead & White, architects; Cook County Hospital, Chicago, Warren H. Milner, architect; Hecker Mausoleum, Detroit, McKim, Mead & White, architects; schoolhouse, No. 18, Buffalo, Aug. C. Esenwein, architect; stable for Mrs. Nearings, Toledo, Ohio, E. O. Falles, architect; Vocke Building, Napoleon, Ohio, E. O. Falles, architect.

The New Jersey Terra-cotta Company is making the terra-cotta for office building, 115 Wall Street, New York City, Jardine, Kent & Jardine, architects; office building, 830 Broadway, New York City, Cleverdon & Putzel, architects; High School, Concord, Mass., Chapman, Frazer & Blinn, architects; apartment houses, St. Nicholas Avenue, New York City, Henry Anderson, architect; apartment houses, 146–150 Eighth Avenue, New York City, Thomas R. Jackson, architect; apartment house, Monroe & Hamilton Streets, New York City, Louis F. Heinicke, architect.

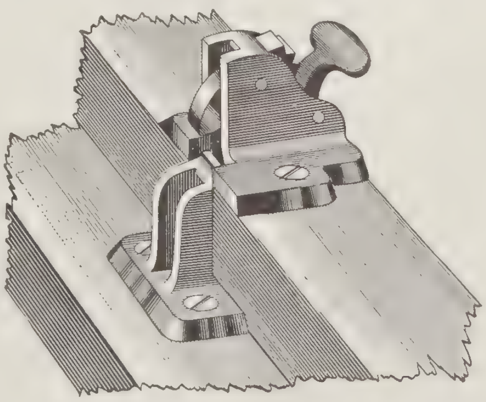
The Grueby Faience Company, 164 Devonshire Street, Boston, has been reorganized and incorporated under the laws of Massachusetts; W. H. Grueby, W. H. Graves, and Geo. P. Kendrick, directors.

Their reproductions of the old Moorish tiles in the dull, soft colors of the originals are attracting a good deal of attention, and Moorish designs and colors are already finding a place in modern baths and smoking rooms.

The brilliant effect of the Grueby faience in a plain white surface can best be seen in a recently completed station of the Boston Subway. This smooth, clean material cannot fail to find favor wherever cleanliness and the absence of the germ of disease is of prime necessity — in hospitals, laboratories, baths, schools, and all public works.

A pretty booklet has come to our notice illustrating the Pancoast ventilators, made by the Pancoast Ventilator Company, 316 Bourse Building, Philadelphia, Penn. It is invaluable for use in offices, sitting rooms, bedrooms, smoking rooms, railroad cars, street cars, churches, court rooms, schoolrooms, public halls, hospitals, etc. The advantages of the ventilator are, efficiency, neatness, durability, and perfection. This firm guarantees to exhaust as many cubic feet of air per minute as any other storm-proof ventilator made. The Pancoast building and chimney ventilators are said to be one of the best ventilators on the market, and are guaranteed to give entire satisfaction. They are made in all sizes of galvanized iron or copper. There are several testimonials contained in this book from people who have used these ventilators, and who praise them very highly. Write the manufacturers for a catalogue.

The Gale Automatic Safety Sash Lock, herewith illustrated, commends itself at once on inspection as being simple and durable (having no springs), and positive in its automatic locking of any window equipped with it on shutting the same, as the sash cannot be closed without the lock fastening the window. This lock does not interfere with the free movement of either sash, and cannot cut or mar the woodwork, even if carelessly used. The lock draws the sashes together in locking them, and will lock those, the meeting rails of which do not close within three eighths of an inch, just as securely as where the meeting rails are flush. If the upper or outside sash has dropped or sagged, the lock will force it up to the head of the frame, and when locked holds the sashes absolutely rigid, and



prevents rattling. A unique feature of the lock is that, in the event of one not closing the lower or inside sash entirely, the window is locked, as the lock fastens at three distinct points. The lifting of the lever or knob releases the lock, and the window unlocks as the sash is raised. For further information regarding this device parties may correspond with Rufus E. Eggleston, 576 Mutual Life Building, Philadelphia, Penn.

WE are in receipt of the following communication from Mr. T. W. Carmichael, inventor and manufacturer of the Carmichael Clay Steamer:—

I beg to call your attention to the great success of my clay steamer by handing you herewith a copy of a letter received from one of my latest customers. This party was in doubt about ever being able to make good pressed brick with his clay, but the steamer did not run longer than five minutes in his presence before he said he was satisfied.

GREEN BAY, WIS., May 22, 1897.

T. W. CARMICHAEL, ESQ., WELLSBURG, W. VA.

My dear Sir: — I am now satisfied our clay will make excellent Dry Press Brick. Your steamer has set us right, and I am now making press brick of the best quality.

If you want a recommendation, write out anything you want and I will sign it.

Respectfully yours,
THE WM. FINNEGAN BRICK COMPANY,
WM. FINNEGAN.

Remember, my steamer is sold on a guaranty. It is my machine until it does work properly. I make it a point to set or start the steamer myself, thus avoiding delay and experimenting. It can in most cases be set at night, so no time is lost.

The following are among my customers for this season:—

James McNeen, La Junta, Colorado.
The Washington Brick & Terra-Cotta Company, Washington, D. C.
Chisholm, Boyd & White Company, Chicago, Ill.
Alumina Shale Brick Company, Bradford, Penn.
Standard Brick Company, McKeesport, Penn.
Alumina Shale Brick Company, Bradford, Penn., second order.
Wm. Finnegan Brick Company, Green Bay, Wis.
Nicholls & Mathews, Wellsburg, W. Va.
Empire Press Brick Company, Denton, Texas.
N. W. Ballentyne, New Cumberland, W. Va.
Gladding, McBean Company, San Francisco, Cal.
Camden Clay Company, Spillman, W. Va.

My claim that "No dry press brick plant is complete without the Carmichael Clay Steamer" receives a practical endorsement in the above list.

TREASURY DEPARTMENT, Office Supervising Architect, Washington, D. C., July 8, 1897. SEALED PROPOSALS will be received at this office until 2 o'clock P. M. on the tenth day of August, 1897, and opened immediately thereafter, for all the labor and materials required for the erection and completion (except heating apparatus, vault doors, and tower clock), of the United States Post-Office, etc., building at Paterson, N. J., in accordance with the drawings and specification, copies of which may be had at this office or the office of the superintendent, at Paterson, N. J. Each bid must be accompanied by a certified check for a sum not less than two per cent. of the amount of the proposal. The right is reserved to reject any or all bids, and to waive any defect or informality in any bid, should it be deemed in the interest of the Government to do so. All proposals received after the time stated for opening will be returned to the bidders. CHAS. E. KEMPER, Acting Supervising Architect.

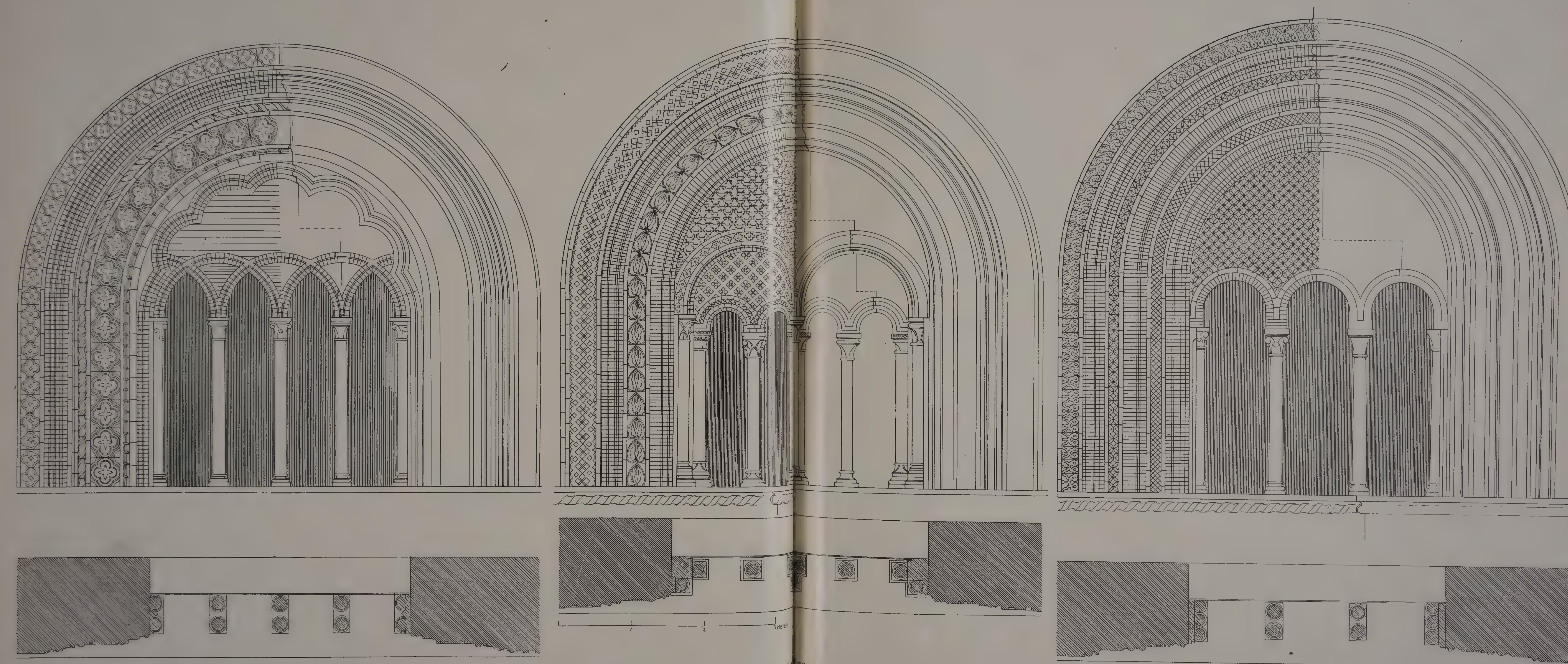
PALAZZO CO
MEASURED AND DRAWN BY GEORGE OA

PALAZZO COMUNALE, PIACENZA.

MEASURED AND DRAWN BY GEORGE OAKLEY TOTTEN, JR., MCKIM TRAVELING FELLOW.

DETAIL OF WINDOWS, P

Measured and Drawn by GEORGE OA



DETAIL OF WINDOWS, PALAZZO COMUNALE, PIACENZA.

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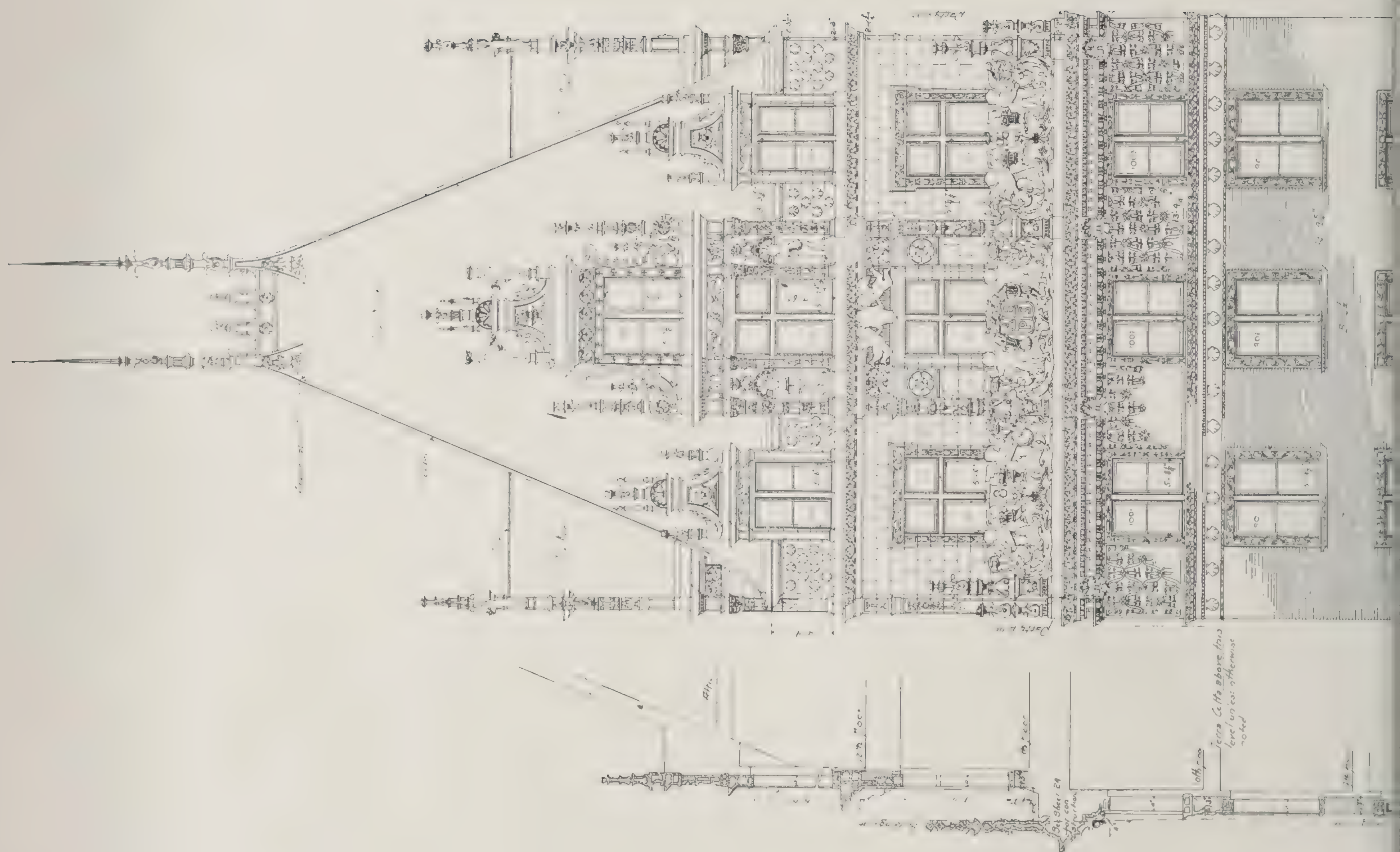
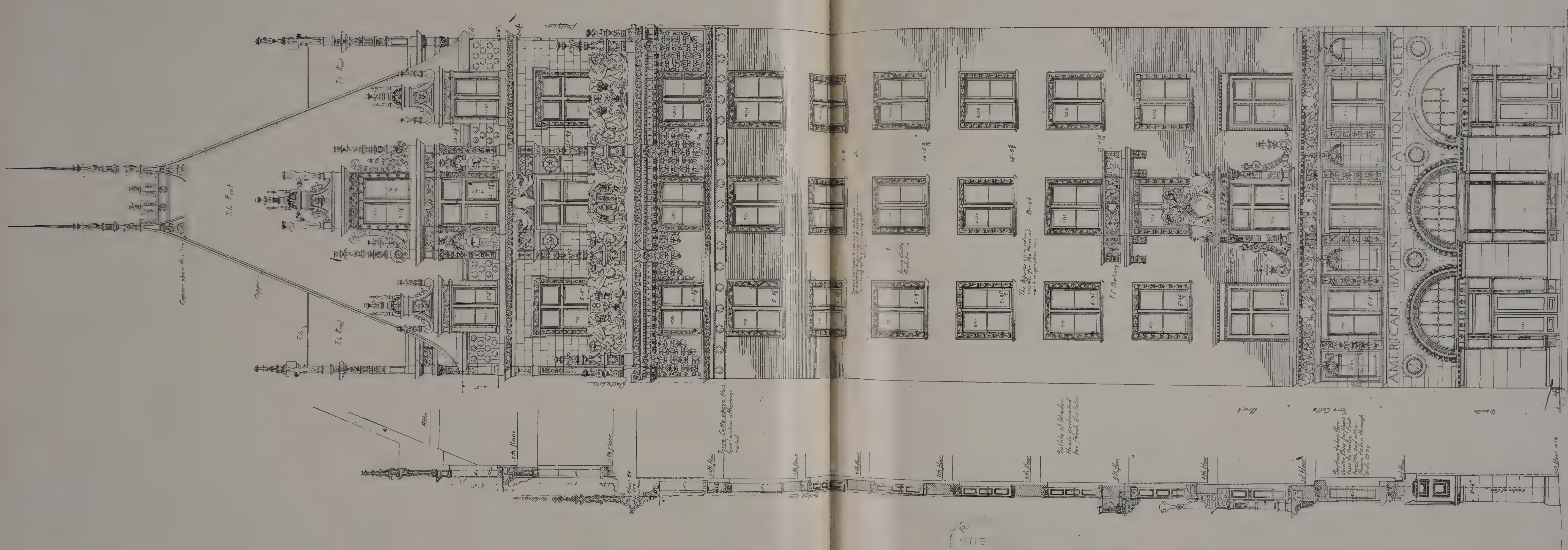
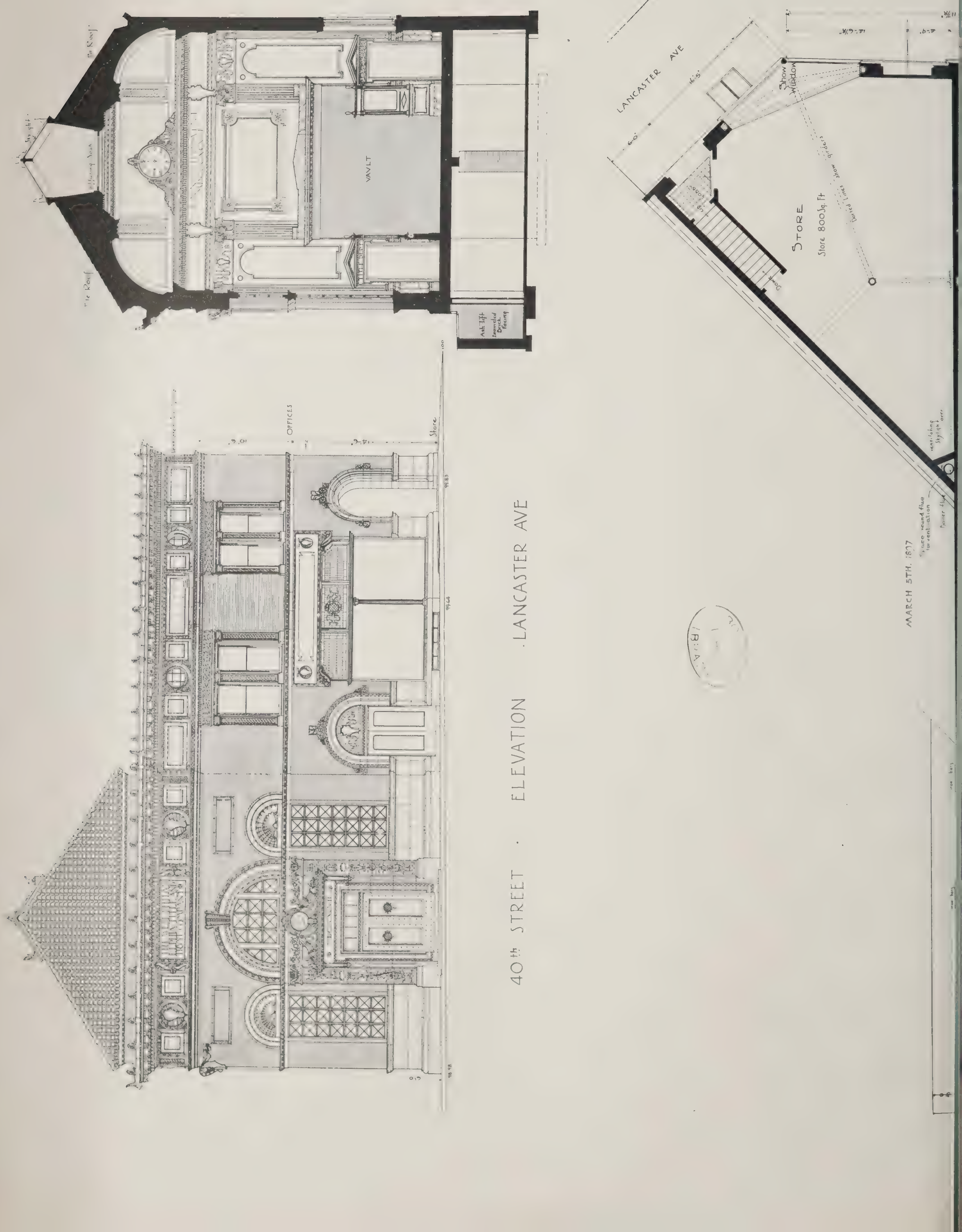
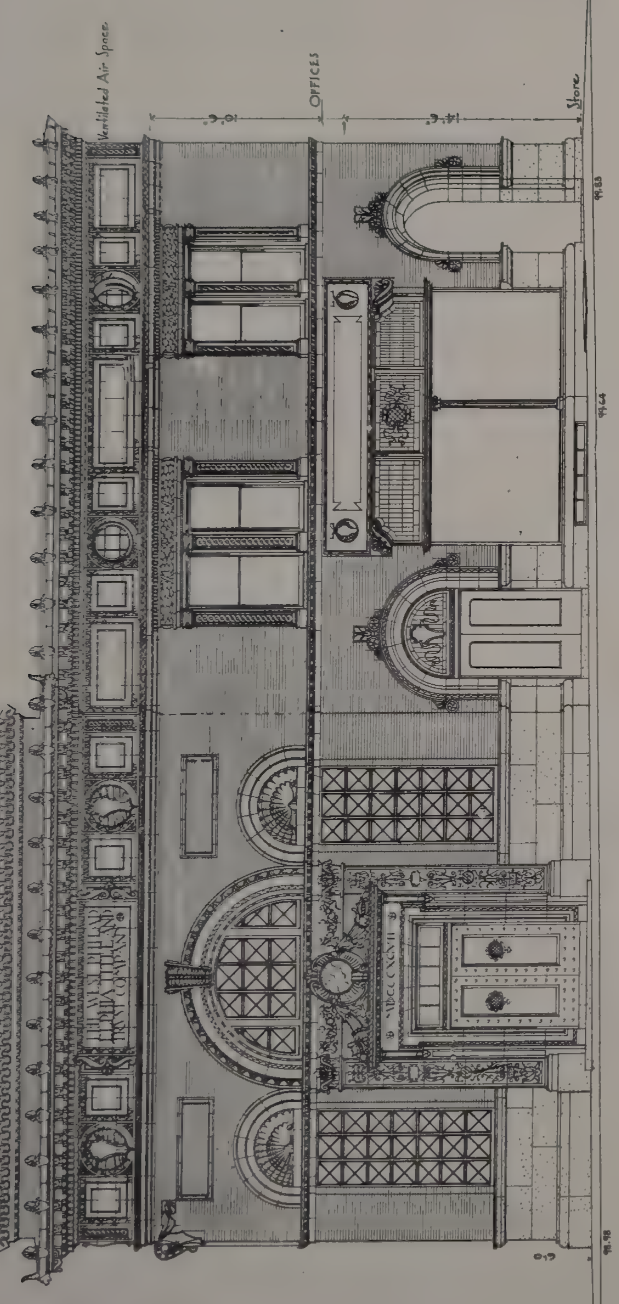




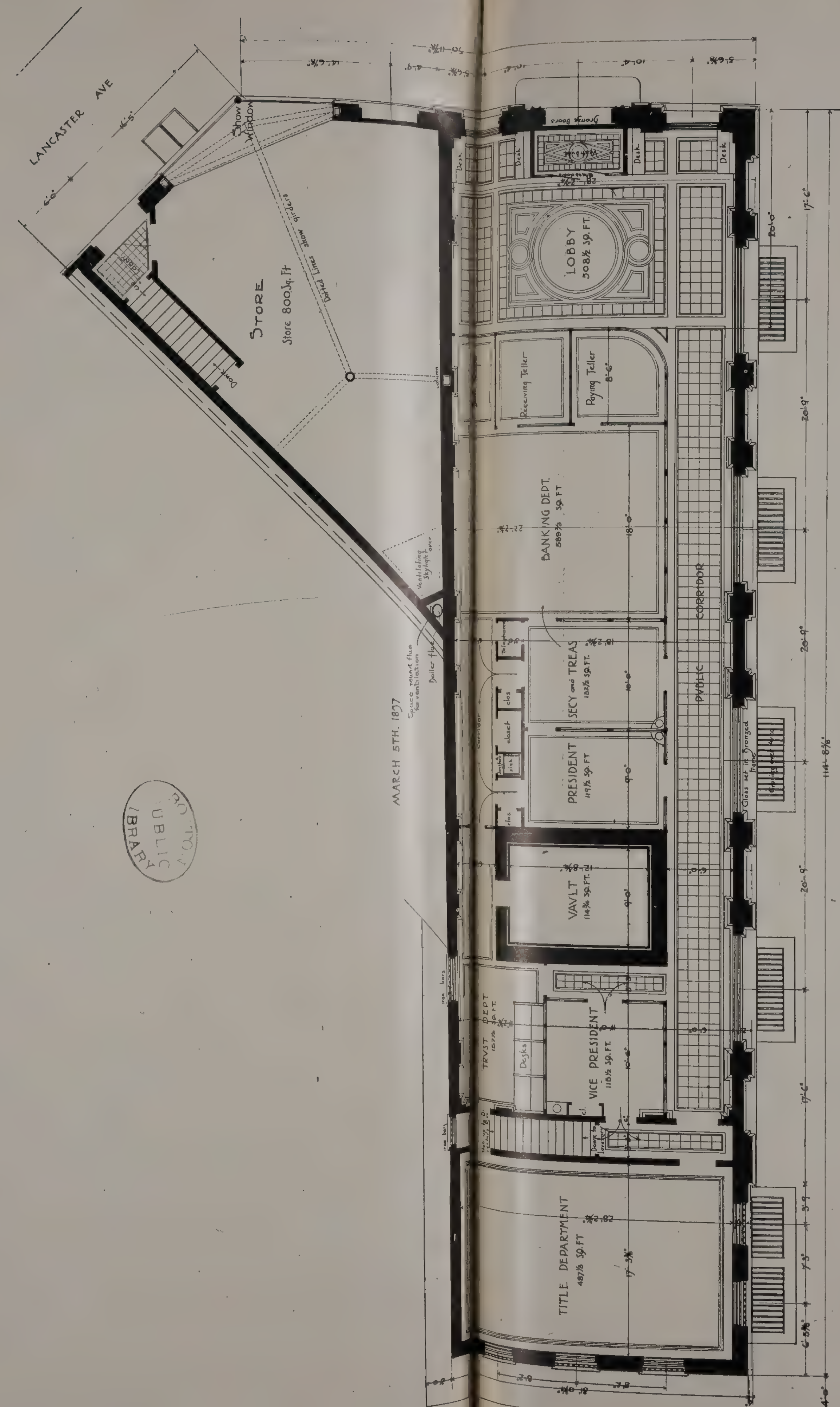
AMERICAN BAPTIST PUBLICATION SOCIETY BUILDING, PHILADELPHIA, PA.

FRANK MILES DAY & BRO., ARCHITECTS.

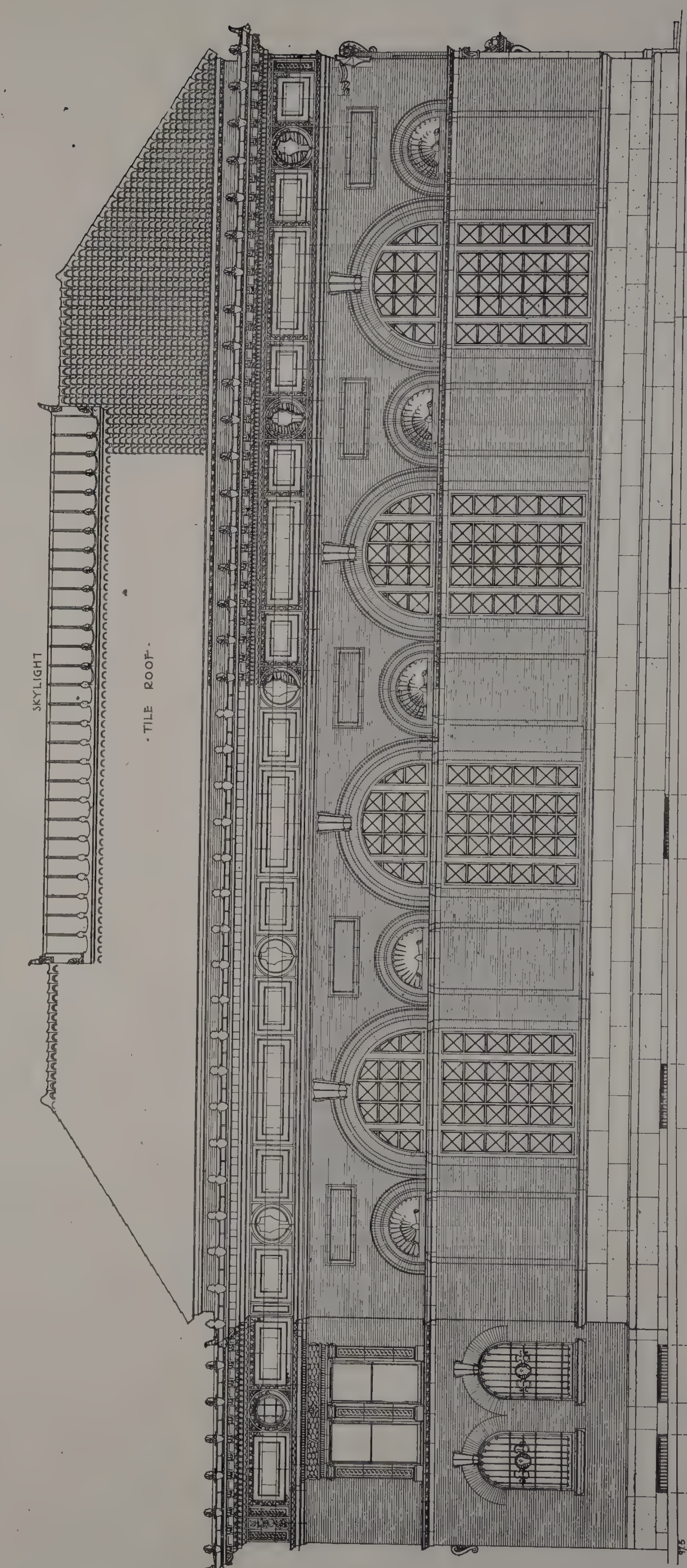

40th STREET · ELEVATION · LANCASTER AVE
VAULT
OFFICES
Store
LANCASTER AVE
Show Window
STORE
Store 800 Sq. Ft
MARCH 5TH. 1897



40th STREET · ELEVATION · LANCASTER AVE



FIRST FLOOR PLAN.



DESIGN SUBMITTED FOR THE WEST PHILADELPHIA TRUST COMPANY BUILDING, PHILADELPHIA, PA.

KENNEDY, HAYS & KELSEY, ARCHITECTS.

VOLVME VI AUG. 1897 No. 8

THE BRICKBVILDER

OFFICE 85 WATER STREET BOSTON

THE BRICKBUILDER.

AN ILLUSTRATED MONTHLY DEVOTED TO THE ADVANCEMENT OF ARCHITECTURE IN MATERIALS OF CLAY.

PUBLISHED BY

ROGERS & MANSON,

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WHEN the use of terra-cotta was revived in England, some thirty years ago, it was then looked upon in the light of an innovation, rather than the re-introduction of a very old building material. Stone and brick, used separately or in combination, had become traditional and time honored in a land of invincible conservatism, whose people — whatever their views as to the first part of the proverb — "meddle not with him that is given to change." Notwithstanding this, terra-cotta was able to maintain a foothold, and of recent years its use has become general. Its durability is conceded, its utility no longer seriously questioned, while its susceptibility to various methods of treatment has been shown to exceed in many ways that of any rival material. These are qualities that appeal strongly to the sentiment, as well as to the business instinct of men who build not merely for their own but for succeeding generations. This, in a general way, is the secret of its growing demand in England, and, to some extent, the reason that underlies its popularity in America.

The estimation in which it is held in the two countries, however, differs considerably. That difference will, we think, be found to coincide with certain phases of national character (on which it is not at this moment necessary to enlarge), as well as with the relative climatic conditions. On this latter point, at least, comparison need not be odious, and may be made instructive. If, for example, bountiful nature has given us our full share of sunshine, there is no reason why we should not make the most of her gift. If, on the other hand, she has given England a moist atmosphere, with abundant supply of soft coal — therefore a comparatively gloomy outlook — its inhabitants do well to accept the situation without murmur or querulous complaint. They, however, have done and are doing more than this. Taking a leaf out of nature's own book, thay have sought to adapt themselves to their inexorable environment. With them terra-cotta has, to a great extent, superseded stone, but is *not* a substitute for, nor is it regarded as an imitation of stone. When chosen, it is by preference and in its own right; not merely on the score of economy, but in view of its greater permanence and, above all, because of its smoke-resisting properties. Hence, it is not used promiscuously on the cheaper classes of property, but usually on work of a very important character. It is almost invariably finished smooth, that it may offer less encouragement for soot to lodge on the surface. For a similar reason it is fired hard, and has a close, vitreous face, so that dirt may not penetrate the pores, causing lasting discoloration.

With us we fear it must be confessed that terra-cotta is often made to change places with stone solely from considerations of cost, or as a compromise, perhaps, between stone and cast iron. How often have we seen it placed in competition with galvanized iron, in which, alas, the cheapness of the latter, acting upon the cupidity of a sordid speculator, gained for it a preference otherwise inexplicable.

In most of the Eastern States, and wherever anthracite coal is the ordinary fuel, the smoke nuisance is not so serious. There is no telling what the future has reserved for us, even in this particular. It may be, as has been remarked metaphorically, that when our chimney has smoked as long as theirs the soot will be just as plentiful. The use of soft coal is certainly on the increase, and the air in all large cities is less free from the products of combustion than formerly. For the present, however, we can afford to stipple or scratch the face of terra-cotta, and sometimes go the length of tooling it "in imitation of stone."

A TOOLED surface cannot be claimed as a logical or natural treatment for a material of plastic origin, and one which, until finished and laid out to dry, is still susceptible to the lightest touch. The stiff mechanical regularity of six or eight cut work is in keeping with the rigid unyielding nature of stone. These cuts tell the story of its manipulation, from the time a large block leaves the quarry until the hewn stones are set in the building. Each cut represents a distinct blow of a mason's mallet on the steel tool by which the cut has been made. It suggests to the mind how stones have been shaped by a persistent use of these tools from time immemorial. We are aware that most of this work is now done by automatic machinery, producing a monotonous regularity, the imitation of which is all the more objectionable. But why attempt to imitate the surface texture of a hewn block in one that has been pressed into shape in a mold? In order to do so the mold has to be specially prepared, the required corrugations of six or eight to the inch being scratched in reverse by means of a steel templet. This, we understand, is the usual method; but whether it is merely the outcome of a conventionality of long standing, or done with deliberate, therefore dishonest, intent, the practice is equally anomalous, and should not be encouraged.

A similar but much more agreeable effect may be produced by the use of a toothed scraper, used directly on the face of each block shortly after it is taken from the mold. The toothing of the scraper may vary from eight to the inch, for work near the eye, to four to the inch on heavy work used on the upper stories of very high buildings.

When the tooling is done in the mold, every block coming from it is an exact duplicate, except in the case of blanks and otherwise defective impressions, which are not easy for the finisher to rectify. On the other hand, when done with the scraper no two pieces are exactly alike, though from the same mold and finished by the same man. These variations, and the slightly undulating movement resulting from hand finish, are among the things that invest the work with a higher degree of artistic merit. At all events, there is much to be said in favor of this method as against the one frequently adopted. Work that has been treated in that way has an added charm which cannot be expected from a series of stereotyped impressions needlessly deprived of all life and individuality.

SOCIETY, ASSOCIATION, AND CLUB NEWS.

THE Thirty-first Annual Convention of the American Institute of Architects will be held at Detroit, Mich., on Wednesday, Thursday, and Friday, Sept. 29, 30, and 31, 1897.

The full details of the program will be announced in a future circular. Papers will be submitted from Prof. C. Francis Osborne, F. A. I. A., of Cornell University; Mr. Henry Van Brunt, F. A. I. A., of Kansas City, and Mr. Cass Gilbert, F. A. I. A., of St. Paul, Minn., on Architectural Education, and its bearing on membership in the Institute. From Mr. Clipston Sturgis, F. A. I. A., of Boston, on Church Architecture, and Mr. H. Rutgers Marshall, F. A. I. A., of New York, on Architectural Truth.

The committee. to which was referred amendments to the Constitution and By-Laws, will report many and radical changes in the hope that they will be adopted, and that they will be so complete and harmonious as to preclude the necessity of changes for a long time to come.

Arrangements will probably be made for a reduction of railroad rates to one fare and a third for the round trip, but this can only be secured by a full attendance at the convention.

The president has appointed Mr. H. Langford Warren, Frank Miles Day, and the secretary of the Institute, committee on the part of the Institute, and the Michigan Chapter has appointed Mr. James Rogers, Jr., Henry J. Meier, Richard E. Raseman, and Frank C. Baldwin, the local committee of arrangements.

The local committee report that arrangements have been made with the Cadillac for headquarters for the Institute. Rooms and board may be had at the Cadillac for $3.00 and $3.50 per day.

THE Eighth Annual Convention of the National Association of Building Inspectors will be held in Detroit, Sept. 14, 15, 16, 17, 1897. The association was formed in June, 1890, for the express purpose of gathering and disseminating practical and useful knowledge, relating to the safe construction of buildings, introduction, and enforcement of the best methods obtainable of building laws.

The suggestions that will come up for consideration are of great variety and interest, among them being: —

Uniformity of safe loads for building floors. Adoption of a system of uniform definitions in building laws. Uniformity of tests of steel construction, and best methods of safeguarding the same against fire. Safe means of ingress and egress. Elevator inspection. Boiler inspection. Ventilation. Sanitation. Plumbing inspection. Gas fixtures inspection. Appointment of building inspectors. Best methods of enforcing building laws. Electric wiring in buildings, etc.

The headquarters of the association will be at the Russell House.

THE charter applied for by the T Square Club, the leading architectural organization of Pennsylvania, and one of the foremost in the country, has just been granted in the courts of Philadelphia, and the club is therefore duly incorporated under the laws of the State of Pennsylvania.

Although but now entering upon its corporate existence, this club has been an energetic organization and a moving factor in the field of its profession for the past fourteen years, having been organized in 1883. The following well-known architects were the founders: Walter Cope, John Stewardson, Wilson Eyre, Jr., R. G. Kennedy, Lindley Johnson, Arthur Truscott, George Paxson, Charles L. Hillman, Clement Remington, Frank Price, Louis C. Baker, and Mr. Carlton.

The purposes of the club, as set forth in the charter and in its constitution, are: "To promote the study and practise of architecture and the kindred arts, to afford its members opportunities for friendly competition in design, and to further the appreciation of architecture by the public." The subscribers to the charter, who constitute the present officers of the club, all of whom are well-known Philadelphia architects or draughtsmen, are: David Knickerbacker Boyd, president; Edgar V. Seeler, vice-president; George B. Page, secretary; Horace H. Burrell, treasurer; Walter Cope, Louis C. Hickman, and Charles Z. Klauder, executive committee, and Adin B. Lacey, Percy Ash, and Charles E. Oelschlager, house committee.

The T Square Club has made its influence felt in various municipal and national affairs, has passed important resolutions on progressive local and other matters, and last fall conducted the Architectural Exhibition in connection with the regular exhibition of painting and sculpture at the Pennsylvania Academy of the Fine Arts. This exhibition was one of the most successful ever held there or elsewhere, being the first in America to contain so many thoroughly representative contributions from foreign architects.

This fall will again see an architectural exhibition, held by this club, which, it is intended, shall surpass any previous one, both in the number and the interest of the exhibits. Representatives of the club are now in England and France, securing the best drawings, and a number of exhibits are promised from other countries.

The Club has also sent Mr. Albert Kelsey to represent it at the International Congress of Architects, to be held in Brussels, Belgium, in the latter part of this August.

PLATE ILLUSTRATIONS.

PLATE 65. A brick residence at Madison, N. J., Clinton & Russell, architects. A half-tone illustration made from a photograph of the building will be found on another page of this number.

Plate 66. Mr. Goodhue's splendid drawing of the church of St. Andrew by the Sea, Edgartown, Mass., Cram, Wentworth & Goodhue, architects. It is constructed entirely of brick, the interior being also finished in the same material. The main floor is of concrete, and in every respect the construction is of the most durable quality. The ceiling is of spruce, stained dark brown, and the finish and furniture of oak, the same color. The windows are filled with cathedral glass, in wide, heavy leads. The roof is covered with green slates. In spite of the nature of the construction, the cost of the entire building, including heating, furniture, pews, etc., will be $15,000, practically the sum that the same structure would have cost had it been built of wood. This church is the result of an attempt to build a small structure for a country parish, solid in construction, and with a certain degree of architectural effect, for a very limited amount of money.

Plates 67 and 68. An office building for the Proctor estate, Boston, Winslow & Wetherell, architects. The exterior of the building, with the exception of granite foundations, is entirely of terra-cotta ashlar. The results obtained in the designing and construction of this building are particularly successful, and as an example of the adaptation of the Spanish Renaissance to a modern building is very satisfactory. By the use of terra-cotta, the varied and elaborate ornamentation is carried out at a reasonably small cost when compared with carved stone.

Plates 69 and 70. Detail drawings of the building for the Proctor Estate.

Plates 70 and 72. Public bath houses at Crescent Beach, Mass., Stickney & Austin, architects.

The building is 80 ft. long and 75 ft. deep. On either side of the building are large yards containing commodious dressing rooms, to be used in connection with sea bathing. Connected with the building in the rear are two low, wooden sheds for the storage of bicycles. The yards are enclosed by the brick wall and the walls of the administration building, and by the bicycle sheds in the rear.

The monotony of the wall is relieved by the use of red and black brick placed alternately. Numerous entrances connect the main building with the yards.

The accommodations for the care of bicycles are beyond criticism. One may ride to the bath-house on his machine, and for five cents have it cared for. While in the bicycle sheds the machines are placed in racks that cannot injure the bicycles. There are enough racks provided to care for 1,225 machines at one time.

A small but complete hospital is connected with the establishment. A half-drowned bather, or any one suffering from accident, or overcome by illness, will receive prompt treatment in this room, which is on the lower floor of the building. Stretchers, an operating table, splints, a complete set of surgical instruments, and all other implements usually found in hospitals are here.

Near the hospital, and hidden from general observation, is a detention room, that will be used as a temporary prison for disorderly persons.

The laundry occupies the greater part of the upper story of the building. This laundry has a floor space of 80 by 70 ft. It is floored with asphalt, and the floor is guttered so that the water from the machines and condensation of steam is carried off into the drains.

Two gigantic washing machines are capable of washing five hundred suits at one time. After the suits have been washed they are put in two wringers, and all the water taken from them. They then go into large drying rooms, where the temperature is 210 degs. Fahr., and are dried within ten minutes. The suits then pass through the hands of an examiner, whose business it is to find rents in them, if there are any to be found.

Upon entering the building, the visitor finds himself in a large rotunda, very high studded, and finished artistically. The floor is of the finest asphalt. In this room hard wood railings guide the patrons along counters, at which they are to be served with keys, suits, etc. The men pass to the right and the women to the left. Behind these counters the large room for the storage of bathing suits is located, and is so arranged that suits of any size can be taken instantly from racks holding more than one thousand garments.

A person desiring to hire a suit and room first buys a ticket.

After securing a ticket, the patron passes along the counter to where the suits and keys of the rooms are given out. Then he passes a registering turnstile and goes into a small room, where he deposits his valuables. The system devised for the care of valuables is interesting and safe.

The valuables are placed in a large envelope by the patron himself, who then writes his name across the back of the sealed envelope. He is given a check that will secure the return of his valuables when he leaves his room after his bath. He receives his valuables from a room on the lower floor, directly below the apartment where he left them. They have been sent down on an elevator, and await him there. He is required to write his name on a book kept for that purpose, and thus he furnishes a positive identification of his envelope and a receipt for the goods.

After the customer has deposited his valuables he passes out into the yard containing the dressing rooms. The men's yard is much the larger, and contains 602 rooms. The women's yard contains 400 rooms. The dressing rooms are arranged on two tiers, or stories, and are planned so that the corridors on the basement story are open to the sky as well as those on the upper tier. The bath-houses in these yards are roofed with gravel and tar. They average 4 ft. by 6 ft. on the lower tier, and 4 ft. by 4½ ft. in the upper story. Only one person is allowed in a room, except where small children are accompanied by parents or guardians. Each room contains a good plate glass mirror, and each bather is furnished with a large Turkish towel.

When prepared to go into the water the bathers reach the beach through subways or passages that go under the boulevard and the shelter that is in front of the bath-house. This is one of the greatest features of the whole establishment, and will be welcomed by those who do not care to go through a crowd of loungers while in bathing costume.

The care for the comfort of the bathers continues even after they have left the subway, for long runs of asphalt have been constructed so as to reach far toward the water's edge, thus relieving the barefooted bather from the pain of walking over the pebbles near the crest of the beach.

After leaving the water, entrance to the bath-house is gained by the same subways, and here the bathers find shower and foot-baths ready for their use.

ILLUSTRATED ADVERTISEMENTS.

IN the advertisement of Fiske, Homes & Co., page vii, is illustrated another of their new and handsome designs of brick and terra-cotta fireplace mantels. The mantel is designed by H. B. Ball, architect, and rendered by H. F. Briscoe.

The Excelsior Terra-Cotta Company illustrate in their advertisement, page iv, a series of terra-cotta details used in the new building, corner Waverly Place and Greene Streets, New York City. R. Maynicke, architect.

EXECUTED BY THE NEW YORK ARCHITECTURAL TERRA-COTTA COMPANY.
J. E. Sperry, Architect, Baltimore, Md.

The new bank building, Montogue Street, Brooklyn, Wm. H. Beers, architect, is shown in the advertisement of the New Jersey Terra-Cotta Company, page viii.

A residence at Alleghany, Penn., Longfellow, Alden & Harlow, architects, is shown in the advertisement of Harbison & Walker, page xxv.

Another residence at Chicago, of which A. F. Hussander is the architect, is illustrated in the advertisement of Charles T. Harris, Lessee Celedon Terra-Cotta Company, page xxix.

Three views of a half-timbered and stone residence, Renwick, Aspinwall & Owen, architects, are shown in the advertisement of the Gilbreth Seam Face Granite Company, page xxxviii.

Brick versus Wood. II.

BY R. CLIPSTON STURGIS.

IN my previous article I have considered the advisability of using brick in preference to wood on account of its durability, economy, and beauty. I want now to show how wide has been the use of brick, and with what admirable results it has been used for all sorts of places and for all classes of buildings.

In the city one naturally expects to find brick; compared with other fire-resisting materials it is cheap, and has, therefore, every reason to commend its use. It is, indeed, somewhat curious, under these circumstances, to find anything else used for mercantile or business buildings, for it is cheap, easily obtained, quickly laid, and, above all, the most fire-proof of all materials.

WORTHINGTON BUILDING, STATE STREET, BOSTON.
Fehmer & Page, Architects.

There seems, however, a general feeling that stone, however common, even if it be mere split granite, is finer or more imposing than brick; and one has recently seen the incongruity of a fine building, open on four sides, faced on the two important sides with plain, dressed granite, without relief or ornament (unless a metal cornice may count for such), and red brick on the two other sides, equally exposed to view, and yet deemed less important.

An harmonious whole of good brick would certainly have been better, and probably cheaper.

The illustration of the Worthington Building, State Street, Boston, is a good example of simple yet dignified brick in an office building.

That it is not unsuited for a city house, even one of some dignity and cost, is, I think, fairly well shown by the Lyman House, on Beacon Street, and the charming houses on the Bay State Road, Boston, by Wheelwright, and by Little and Browne.

As soon as one gets outside of the fire limits, however, one finds brick discarded for houses, though the fact that even here it is sometimes used for buildings of more importance shows that it is looked upon as a material superior to wood.

The fear of expense, which I tried to show groundless in my last article, is, doubtless, still the chief cause for our wretched wooden suburbs. If only people would realize how inexpensive, how neat, and how compact is a suburb nicely laid out with brick houses, perhaps they would be led to at least try the experiment of a brick house for themselves. I have shown in an illustration of the first article a few cottages in Bedford Park, a London suburb. They were built by Norman Shaw, and were, I believe, inexpensive houses; and for good cheap cottages I would refer the reader to some of the facts and figures about the brick cottages built on some public land by the city of Birmingham, and forming a paying investment when rented at eight pounds a year.

CHARLESGATE STABLES, BOSTON.
Peabody & Stearns, Architects.

I am sorry to say that I cannot illustrate many good examples of cheap brick suburban houses in this country, because there are so few. The brick blocks which have here and there crept out from the city are mere city blocks, generally poor ones at that, misplaced, but the one illustration I have (a house in Newton) is a good one, and I hope may be productive of more like it.

If the ordinary householder is prejudiced against a brick house in the suburbs, his face is rigidly set against it in the country. Here it is not only the argument about expense, but also the plea as to the appropriateness of wood in the country. For myself, I can see the appropriateness if it is a really wooded country and the timber is at hand, just as stone becomes appropriate if one lives by a quarry; but otherwise I see no reason why brick is not far more appropriate, for if you anywhere want a permanent, dry, warm house, it is in the

LOWER SCHOOL AT ST. PAUL'S, CONCORD, N. H.
Henry Vaughn, Architect

country, where you are exposed on all four sides to wind, and rain, and sun. If anywhere you want a house wall on which you can grow vines without tearing them down every few years to paint, it is in

RESIDENCE, BAY STATE ROAD, BOSTON.
Little & Brown, Architects.

the country. If anywhere you want a wall which requires little care or repair, it is in the country, where mechanics are not always convenient or competent. Brick seems to me, then, appropriate for city, for suburb, for country; and if appropriate for these various localities, it is also appropriate for the various classes of buildings, for houses, as we have said, and also for churches, public buildings, warehouses, and barns.

In churches we can point to many beautiful examples. There are the churches and towers of Rome; the Frari in Venice. There are many interesting massive towers of the Lowlands (Flemish and Dutch) which have been illustrated in a previous article in THE BRICKBUILDER. Here and there a good bit in England. Some old, like St. Albans tower. Some new, like Holy Trinity, Sloane Square, (Sedding's) — and as a modern following of Italian ways, the Judson Memorial Church on Washington Square, New York, the work, I think, of one of that gifted firm who have done so much for American architecture. These are no mean examples to show that brick has its place in church architecture.

HOUSE AT NEWTON, MASS.
E. H. Benton, Architect.

To pass from church to public buildings, one might call to mind Shaw's Scotland Yard in London, or our own modest little Independence Hall, and one might add innumerable town halls in Holland, and the St. James Palace in London. There are not, however, many important examples among large public buildings; much yet remains for brick to do in that field.

If schools come under the head of public buildings, we can point to numberless examples: Vaughn's Lower School at St. Paul's, and Wheelwright's well-known work for the city of Boston, buildings very different in their style and yet each charming in its way. Vaughn's work has little or no attempt at ornament, very quiet and refined, distinctly English in its whole feeling, looking thoroughly suited for its purpose, and most naturally English, for to England we must look for precedent in such schools; and Wheelwright's work, of ornamental brick, Italian in character, yet distinctly scholastic. Red brick is not wholly to be commended for interiors, and the halls and large rooms of Vaughn's school, which show dark-red walls,— red jointed, too,— are somber and forbidding, hardly a cheerful atmosphere for study. There are very many excellent examples of good brickwork in this class, but there is plenty of room for improvement and for a more general use of brick.

Under warehouses we can include the familiar great Cloth Hall

RESIDENCES, BAY STATE ROAD, BOSTON.
Wheelwright & Haven, Architects.

at Ypres; and the Waag at Amsterdam, and innumerable good buildings in our larger cities, of which the storage warehouse is a specially apt example, for we here have a building of considerable merit, and yet hardly a single opening to give opportunity to the architect. And we might in this class include that delightful brick and stone stable and carriage storehouse which Mr. Peabody built in Boston. And finally, in England we find real barns here and there, and plenty of stables of good honest brick, which speaks of certain assurance of permanency, and gives us a comfortable feeling that the owner expects to work and live long, tilling the soil and garnering his hay and corn. These buildings show brick in an attractive light from every point of view, — economical for the investor to build, a good risk for the insurance companies, and a beautiful building to delight the artist. And we see that there is most excellent precedent for the use of brick, in city and country, for houses and churches, for public and private buildings.

Architectural Terra-Cotta.

BY THOMAS CUSACK.

(Continued.)

THE Chamber of Commerce Building, Rochester, N. Y., designed by Messrs. Nolan, Nolan & Stern, of that city, affords an excellent example of terra-cotta architecture, in which that material is used consistently, in combination with brick, from sidewalk to corona. The first and mezzanine stories are, perforce, an expanse of plate glass, admitting of nothing save a series of piers, windows and doorways, of which, however, the most has been made. On the story above, with its rusticated piers and two horizontal courses, entirely of terra-cotta, considerable elaboration has been bestowed; at the same time the idea of homogeneity, so much needed at this point, is happily preserved. The succeeding eight stories are exact duplicates, and in this the exterior proclaims the nature and purpose of the interior with admirable candor. In the twelfth story, which is also wholly in terra-cotta, the laws of perspective, and the effect of foreshortening have been studied to some account. Figs. 29 and 30 will show that the embellishments have been carried out on a scale that is legible from the street, and not, as too often happens, reserved for the delectation of the feathered tribe.

This building has already been briefly referred to in connection with banded columns, of which it has two very good ones at the principal entrance. The business at present in hand is primarily one of cornice construction, and of that, too, it affords a typical example that may now be described, and made the subject of adequate illustration.

This cornice is 8 ft. 9 ins. high, and, having a total projection of 5 ft. from wall line to nose of lion's head, requires a well-devised scheme of structural support. The one that was adopted is shown in detail at Fig. 31. To the Z bar columns that extend up through the piers is bracketed, horizontally, a 10 in. I beam. This acts as the fulcrum to a series of 6 in. I beams that project over each modillion, the opposite end of which is attached to roof beams by means of a stirrup. These cantilevers, in addition to the weight that rests on top of them, are strong enough to support the modillions also. This they are made to do by the application of two ¾ in. hangers, which, taking hold of a short bar inserted in the modillion, pass up through a plate laid across the cantilever, and are then tightened up to required tension. The dental course, and the panels between modillions have each a hole into which a rod is passed, and from it they are anchored back through the wall.

The modillions are spaced on 3 ft., 8 in. centers, which, all things considered, rendered it inadvisable to make the soffit blocks in a single piece. They are therefore jointed into three, for greater convenience of handling and of setting, as well as in the making. This allows the two side pieces to be fitted into the flanges, and bedded down on each side of the cantilever. The center piece, to which the coffer panel is attached, is then dropped in as a key, and the whole course is thus made immovable. A hole is provided in blocks forming cima, into which short pieces of round iron are inserted, and from those they are secured by diagonal braces at intervals, riveted to the 6 in. I beams, as indicated in section. In view of subsequent criticism and comment on the deterioration of iron and steel, when used in a similar way, let it be noted that the top surface of this cornice like the one given in last example, is also covered with copper.

FIG. 29. CHAMBER OF COMMERCE BUILDING, ROCHESTER, N. Y.
Nolan, Nolan & Stern, Architects.

Among recent communications on the subject of cornice construction, there is one from Mr. J. E. Sperry, of Baltimore, that calls for special notice. In it he reaffirms the superiority of cast iron as distinguished from rolled sections. As for steel, he doubts the propriety of using it at all, in situations where it is likely to suffer from rust, adding: "I should hesitate to use structural steel, except in the inside of a building where it was not liable to be assailed by dampness. In cornice work, though the steel is in a measure protected by terra-cotta, it would not be entirely free from atmospheric influences, which would in the course of time cause disintegration not likely to occur in the case of cast iron."

Mr. Sperry is probably right in discriminating between iron and steel sections, and in giving the preference to the former of these two materials. The introduction of steel for structural purposes has been so recent that there has not been time for a conclusive test of its comparative durability. Its flexibility, as well as its stiffness, is allowed to be much greater than those of iron, but we think it is generally conceded among engineers that it should not be subjected to varying

FIG. 30. TWELFTH STORY CHAMBER OF COMMERCE BUILDING, ROCHESTER, N. Y.

degrees of dampness, from wet to dry, and in situations where it cannot be repainted. We have noticed a marked deterioration in the case of corrugated roofing plates, even when galvanized, and though steel is now the more generally used of the two for that purpose, its popularity is probably owing to its relative cheapness, and not to anything that can be said in favor of its durability. The laminæ in the texture of steel is more pronounced than in that of iron, and the scaling off that follows as a result of, oxidation appears to be correspondingly rapid and destructive in its action.

In the case of cast iron, however, it must be remembered that it, too, has defects of another and far more treacherous kind, which it is difficult to detect, and impossible to guard against even under the most rigid supervision. Sand-holes and blow-holes frequently occur in ordinary castings, but they are usually concealed by a convenient coat of paint, for which most foundrymen evince an easily understood predilection. It is for this reason that cast iron has been abandoned in bridge building, and is now superseded in all structural work where the load is eccentric and the strain as variable as the wind pressure.

The foregoing objections to the use of rolled iron are valid up to a certain point, but by no means vital. We have already urged, as a sufficient set-off, the advisability of having all hangers, anchors, and cantilevers galvanized. This is now being done on several buildings in course of erection, one of which is in Baltimore, and for it we are pleased to know that Mr. Sperry is the architect. The new Delmonico Building on Fifth Avenue and 44th Street, New York, is another, and on it Mr. J. B. Lord has insisted that all special ironwork coming into contact with the terra-cotta be galvanized. When this is done there is no room for hesitation in the use of wrought iron, and no reason to doubt the permanent security of a properly constructed terra-cotta cornice, with it as the chief auxiliary support.

As a further step in the right direction, attention has likewise been directed to the importance of keeping water from entering the joints. This, however, is one of the things so frequently neglected that it may be well to reiterate the warning, and at the same time to indicate some of the ways in which the desired end may be attained.

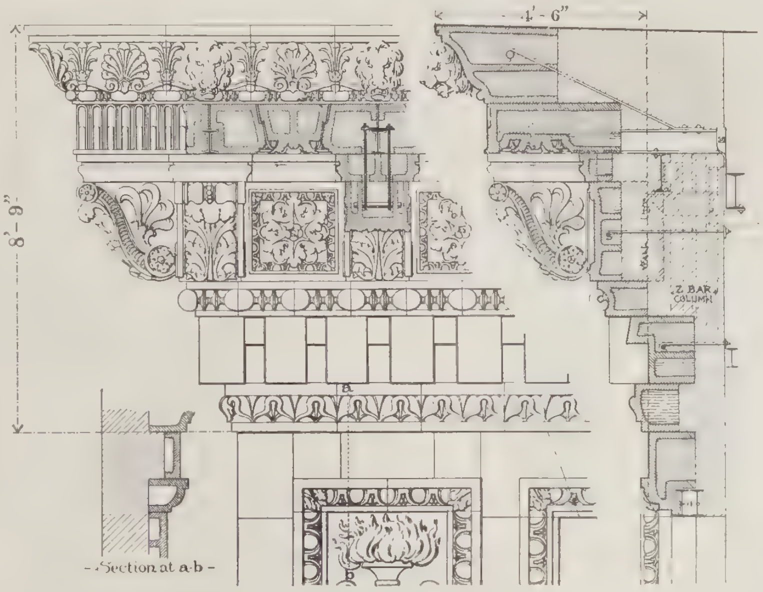


FIG. 31.

A covering of copper, on all surfaces having a wide projection, is one very effectual method; but a fatal error is often made in the provision for fastening down the outer edge. Instead of turning the metal clear over the nose, as at A (Fig. 32), or providing a roll and quirk some distance back, as at B, architects sometimes call for a raggle to be sunk into the top surface, as at C. This latter plan may appear all right on paper; it may also satisfy a draughtsman who looks upon his drawing, not as a means to an end, but as an end in itself. In practise, however, it is a most objectionable method, and is liable to promote some of the things it had been intended to prevent. When the edge of the copper has been inserted in this groove, the metal worker drives in, at intervals, lead plugs to hold it down; if lead is not at hand, he contents himself with wedges of wood, which serve his turn as well. The mason then fills up what is left of the raggle with mortar or cement, which remains until after the job has been cleaned down. If well done, this may remain for a year or two longer, but it cannot be regarded as permanent. When it wears out — as sooner or later it is bound to do — this channel gets filled with water, which soaks into the blocks, and expands every time the temperature falls below freezing point. The nose, which has been weakened by the groove in the first instance, is then liable to break off, and whether it be from the third or from the twenty-third story, when it falls the consequences are equally disquieting. In work of a light color an architect may not want the copper to show on top member of cornice. In that case he has the alternative method at B, to which there can be no reasonable objection, and by adopting it he escapes all risk of a disaster such as he invites by making a groove along the wash.

Where a copper covering is not provided, the joints may be rendered perfectly secure in the way shown at D, Fig. 32. A dovetail rebate is molded in the ends of the blocks, as drawn in section at X. X. Vertical channels are likewise made to receive grout, which is poured in from the top, after the course has been set to line. The dovetail cavity so formed is then filled flush with granolithic; or a good brand of cement gauged with an equal quantity of clean, sharp sand may be used. A filling of this kind cannot work out, and the size of the body is a guarantee against its cracking or scaling off. Several important cornices, with the particulars of which the writer is acquainted, have had the joints protected in this manner, and in every instance with good results.

One of these was set about six years ago, and we can say, from a critical inspection made at the date of writing, that the joints are still in perfect condition, though nothing whatever in the way of pointing has been done during that interval. Let the blocks receive a hard metallic glaze (on the wash only), and let them be fired to the point of vitrifaction; no other covering will then be necessary, and a cornice so constructed will continue intact as long as the building remains in existence.

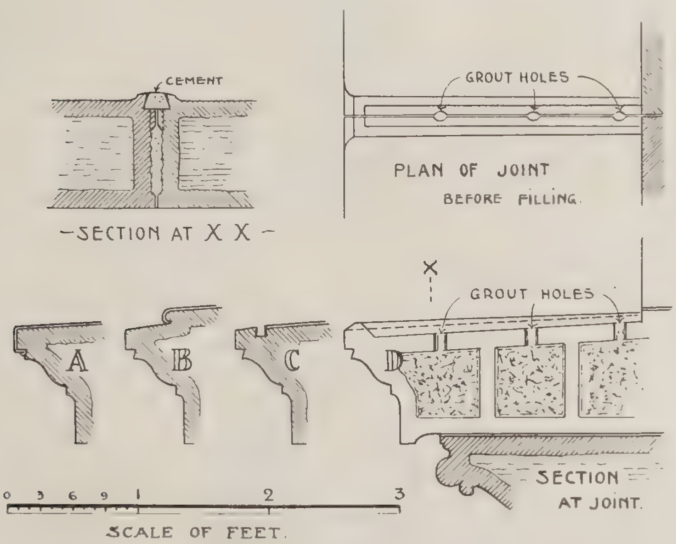


FIG. 32.

Continued.

The Art of Building among the Romans.

Translated from the French of AUGUSTE CHOISY by Arthur J. Dillon.

CHAPTER III.

PART III.

HISTORICAL ESSAY ON THE ART OF BUILDING AMONG THE ROMANS.

CHAPTER I.

FORMATION AND DECLINE OF LOCAL METHODS.

LOCAL SCHOOLS.

IT happens that in demonstrating the methods of the Roman art the examples cited in support of the same idea have been taken from different countries, and even sometimes from different epochs. It may be asked if the Roman art had such unity that it is possible to thus compare monuments of so many different provinces and centuries; the question is answered in part by the uniformity of the results of such a comparison. But let us be careful, however, of exaggerating this uniformity; it existed, it was possible, only in the principles, and excluded neither the progress that comes from the long practise of the same methods, nor those slight variations which arise in any system of construction in the process of adaptation to different climates. Construction had its local schools; it escaped neither the influence of foreign examples nor the vicissitudes of the internal condition of Rome. Tuscan when Rome was still one of the cities of Etruria, it took bit by bit the imprint of the Hellenic spirit, when brought into contact with Grecian civilization; and its originality lay less in creating new types than in grouping those already existing into a new system. We have indicated, in speaking of cut-stone construction, some of the ideas taken from Greece and Etruria; in order to mark these more clearly, and to decide the circumstances which brought foreign methods into use among the Romans, it would be necessary to enter into the field of conjecture, and to study the art of building in connection with the political relations of Rome. We will not attempt this difficult research; leaving aside the period when the Romans were satisfied in imitating the models of Etruria or of Greece, we will take as a starting point the time when they initiated the only methods that are strictly their own, those of concrete construction.

The appearance of concrete vaults in the Roman monuments must be placed at the last years before the Christian era. No doubt long trials had prepared for this important innovation, but no certain trace of them can be found either in ruins or in books. Vitruvius himself, writing but a few years before the laying of the foundation of the Baths of Agrippa, does not seem to suspect the great part that concrete vaults are about to play. The art of which he treats was at the point of entire transformation, yet nothing authorizes us to conclude that Vitruvius foresaw this change: so rapid was the progress of concrete construction, so sudden and unexpected was this revolution of Roman architecture.

What causes, then, determined this brusque revolution in the art under the government of Agrippa? Several come so naturally to mind that it is sufficient to mention them; public wealth had increased suddenly after a period of internal commotion and foreign war; thanks to an interval of calm, the new methods were applied on a grand scale for the first time, and had an opportunity of bold development; Agrippa saw in the embellishment of Rome a means of making its people forget their ancient political life, and put himself at the head of the movement; under his administration Rome was filled with edifices consecrated to the pleasures and festivals of the Romans; the ancient city was soon too small to contain all of them, and it became necessary to infringe even on the Field of Mars. It is, I think, in this double influence of customs and politics that the causes of the sudden advance in the art of building at the commencement of the imperial rule must be sought. Methods were henceforward definitely fixed, and the art of building, once systematized, remained stationary at its highest point of perfection for a period of more than three and one half centuries.

This fact, remarkable in itself, becomes of great interest when it is considered that it was during the decline of all the arts that the traditions of good construction were preserved without alteration—and also without progress. Even the causes that affected architecture seem to have had little or no influence on the art of building; ornament and construction had become almost entirely independent; and hence their development or decadence was according to different or even contrary laws. Under the Antonines construction was the same as under the Cæsars, although architecture was visibly modified in the intervening century. At the end of the third century architecture was in full decadence, while the art of building, still flourishing, produced the Baths of Diocletian. After Diocletian, art still degenerated; and, by a curious coincidence, the architects who could do no better than strip a monument of Trajan to ornament an arch of Constantine were the contemporaries of the daring builders who covered the naves of the Basilica of Maxentius with those magnificent vaults whose ruins still amaze us by their solidity and grandeur.[1] Never had the art of decoration and the art of building offered a stranger and more striking contrast. The discord was at its height, but it was also approaching its end; and under the reign of Constantine, the art of building fell to that degree of abasement which architecture had long before reached.

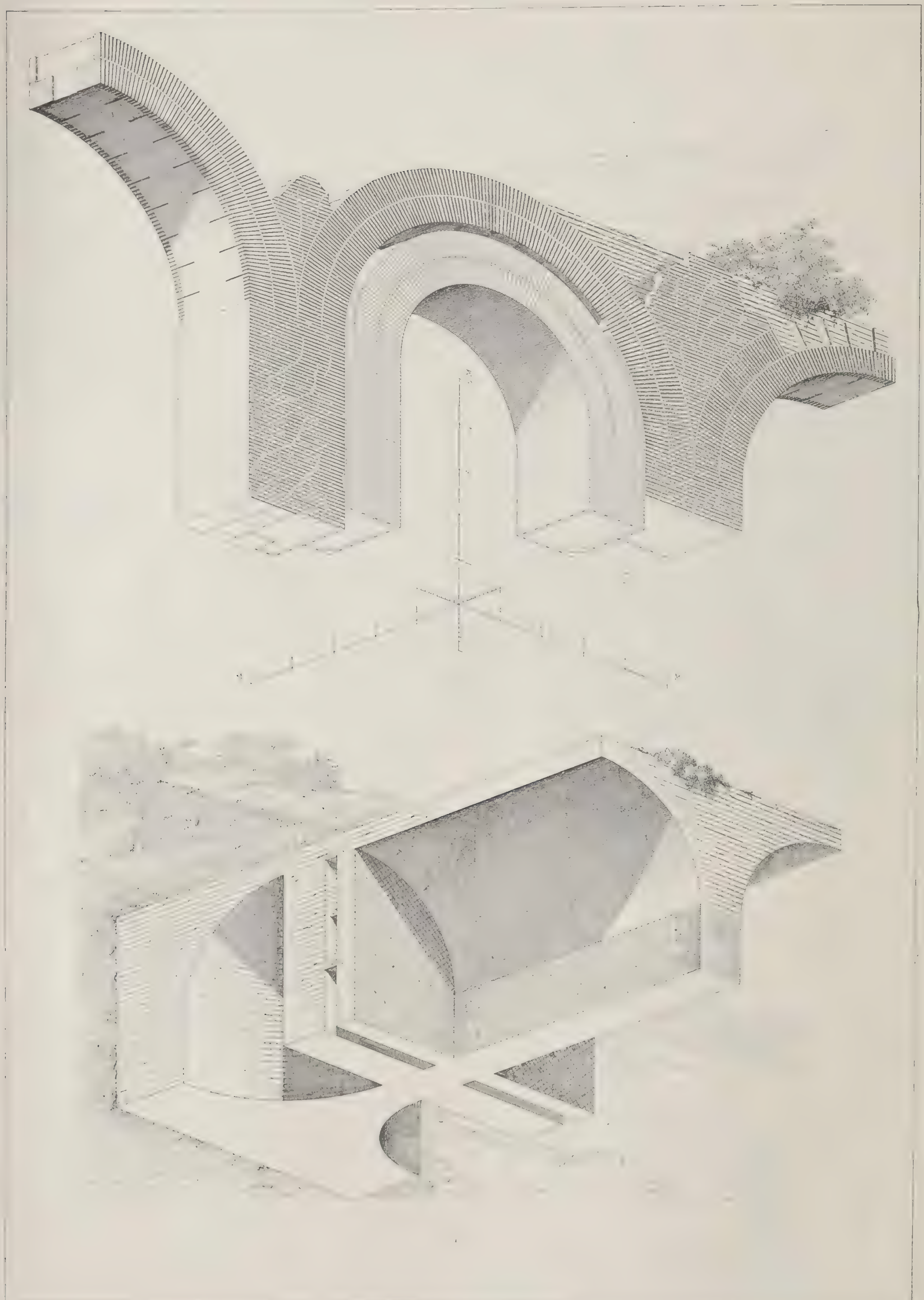
The fall was as brusque as the progress had been rapid; it was but scarcely announced by a few monuments built without due care, such as the circus of Maxentius, near the Appian Way; and at the side of these mediocre productions, practical architecture did not cease to show by its *chefs-d'œuvres* that the old traditions were still maintained. But suddenly this prodigious fecundity was exhausted, and the art of building reverted, as it were, to the point where it had started four centuries before. Its progress had been in the development of vaults, its decline was marked by their almost absolute abandonment. First the traditional methods were used timidly; the monuments of St. Constance and of St. Helen, at the gates of Rome, show the characteristics of this first period; and perhaps we must put at the same date the curious monument called Minerva Medica, where the vacillating and awkward use of the classic methods clearly marks the moment of hesitancy that precedes the centuries of decadence. Vaults — spherical vaults among them — did not cease to be used in sepulchral or religious monuments, but they disappeared almost completely from the great civil buildings. The Christian basilicas of the fourth and fifth century had no vaults, except such as are represented by the arches that spring from column to column; all the rest was roofed with wooden framing. Two centuries went by during which vaults, used only in buildings of little importance, ceased to dominate the general system of construction, to reappear again at the time of the Byzantine Renaissance, but under an entirely new form. The old tradition was definitely broken at Rome,[2] and the rapidity of the changes that took place seems to indicate a cause as violent as it was sudden.

In fact, between the time of Diocletian and the last years of the reign of Constantine, a revolution took place whose influence on the history of Roman construction was not less than its influence on the history of the Roman empire. Rome ceased to be the capital of the Roman world; and the art was transformed the day that Rome, losing its political preponderance, ceded to Byzantium the inheritance of its ancient privileges. The immense buildings of the new capital immediately absorbed the resources of the empire, and the date of its foundation (330) marks the epoch when the sudden and profound

[1] For the actual date of this building, called the Basilica of Constantine, see W. A. Becker, Handbuch der römischen Alterthümer, Part I., pp. 438 et seq.

[2] In some provinces the rupture of the old traditions was less sudden; thus, in the northern part of Gaul, construction was carried on, under Julian, on a scale that recalls that of ancient Rome. The Baths of Paris can with some reason be placed at this date; and their superiority over contemporary edifices in Rome is incontestable.

PANTHEON D'AGRIPPA.
PLATE XIII. THE ART OF BUILDING AMONG THE ROMANS.



1. Villa Hadriana. 2. Aqueduc Pres St. Jean de Latran.
PLATE XIV. THE ART OF BUILDING AMONG THE ROMANS.

transformation of Roman construction, whose principal characteristics we have shown, took place. This explanation must not be thought a pure conjecture. We have the proof of its truth in the singular demand which Constantine made on the pretorian prefect, ruler of both Italy and Africa, to supplement the exhausted resources of Italy: "Architectis quam plurimus opus est, sed quia non sunt . . . " such is the beginning of the first constitution of Constantine on the immunities of artisans (Cod. Theod., Lib. XIII., it. VI., l. 1). This constitution is dated 334, four years after the foundation of Constantinople. It was impossible to formulate more clearly, in an official act, the causes of the decline of architecture in the fourth century. Constantine established schools to save the remains of the ancient art; he founded institutes for the benefit of the young Romans who would agree to devote themselves to the study of architecture; but the efforts were fruitless; new demands had arisen, to meet which it was necessary to do no less than to create an entire system of entirely new methods. Another capital of the world could not be planned with that luxury of material and immovable solidity which we so admire in ancient Rome, when arms were lacking, when means of subjection had to continually be increased in order to obtain sufficient corvees, when even directors of the works were missing. Lighter construction, sacrificing solidity to the demands of endless necessities, was sought; and the venerable practises of the Roman art partially disappeared in the course of this change; the old equilibrium of the working classes was overthrown, and the tradition that had lasted from Augustus to Constantine was suddenly discontinued.

At the same time that the buildings of Constantinople were draining the resources of the empire, the magistrates of the provinces were, in their turn, endeavoring to transform their own residences; and the taste for building increased everywhere just when the means of satisfying it were becoming more and more insufficient. It became necessary to arrest this fad by the constitutions that are repeated, as one might say, on every page of the Code,[1] whose number is in itself an indication of their failure to accomplish their purpose. It was in vain that the emperors prohibited the erection of new public buildings before the completion of those already commenced; it was in vain that they tried to limit the number of these useless works by depriving the magistrates of the honor of placing their names on them; it was in vain that they imposed the onerous duty of assuring their complete achievement on those who commenced them: for fashion, stronger than imperial commands, immeasurably multiplied these senseless enterprises; and the lack of resources, day by day more marked, continually put the builders further from the good traditions of the ancient school. A small number of the monuments of this epoch have lasted until the present time; they are the basilicas, whose duration was prolonged by the pious care of the Christians; but the majority of the buildings of Constantinople had to be rebuilt by the Byzantine emperors. The historian Zosimus even affirms that several collapsed under the reign of Constantine, so hastily had they been constructed. This author, a thorough pagan, is open to the accusation of partiality when he speaks of Constantine, his government, or his religion; his animus can be perceived even in the expressions he uses in speaking of the monuments built by Constantine;[2] nevertheless, his testimony at least shows that the buildings were short lived; and their anticipated ruin seems due to that lack of resources of which the memory has been transmitted to us by the imperial constitutions.

Such was, to sum up, the history of concrete construction; a singular history, whose phases do not seem to follow, as do those of other histories, a law of general continuity. The great decadence of the fourth century was brought about, like the great rise of the last century before our era, without a transition whose monuments might make it possible to retrace its course.

It is no part of our program to study the Roman art such as it became after this last transformation. We have been compelled to limit ourselves to what it was during the long period that commenced during the last years of the republic, and ended at the epoch of the barbarian invasions. Let us now give a glance at the variations that were made in the methods in the different parts of the Roman world.

LOCAL SCHOOLS.

THE ROMAN ART AND THE MUNICIPAL SYSTEM OF THE EMPIRE.

When the Romans invented the system of concrete construction, they certainly created the most suitable instrument for making the methods of the art of building uniform. When they had learned how to erect their colossal vaults, with no other workmen than unskilled laborers, with no material but shapeless stones and mortar, they seemed to have obtained a mode of construction that was destined to become universal. By means of their colonies and legions they pushed the new methods to the farthest limits of the empire. At every point to which the domination of Rome extended, they improvised entire cities, recalling by their general traits the aspect of the metropolis; and these cities became in turn so many centers whence Roman architecture radiated with Roman habits and customs. Thus all tended toward uniformity. Nowhere, however, did the art succeed in acclimating itself without losing some of the characteristics that had marked it at its origin; it was, on the contrary, divided into a series of schools, whose clearly distinct methods reflected by their diversity the infinite variety of local resources and traditions. I could, to show these differences, limit myself to instances of construction properly so called alone, but the shades of difference are still more clearly manifest when the forms of architecture are considered. Compare the monuments of Rome with those of Roman Egypt, and on one side will be found the architecture that is regarded as the official style of the empire; on the other, a collection of types and proportions so similar to as to be mistakable for the art of the time of the Ptolomies; it is known, for instance, that the porticoes of Denderah and Esneh do not date from before the Roman epoch.

In Greece, as well, the Romans conformed to the traditions of the ancient national art. The frontispiece, known as the Entrance to the Agora, is a curious monument of this Grecian school of the empire; a school, without doubt, degenerate, but still essentially Greek, whose works are rude imitations of the ancient Hellenic art, but which borrow nothing from the forms of the contemporary art of Rome.

If other examples of this local architecture which departs from the ordinary types of ancient architecture in Italy are desired, they can be found in the monuments raised in Central Syria during the first centuries of the Christian era. All the edifices of Hauran, in which an ingenious theory finds the origin of the French architecture of the middle ages, are much more like the monuments of France of the twelfth century, both in structure and decoration, than like the edifices of Rome, Egypt, or Athens; a new and striking manifestation of the national traditions that divided Roman art at all periods of its history.

The cities of the western coast and of the southern part of Italy, Pompeii among others, retained their Grecian physiognomy under the empire; in the territory of ancient Etruria, the national tradition gave the edifices, even those of after the conquest, the seal of masculine simplicity so strongly marked in the Roman ruins at Perugia.

We also had our architecture of the period of the Emperors;

[1] Here are some of them: —

1st. Prohibition against undertaking new buildings before finishing those already commenced.

Code Theod., Lib. XV., tit. I., l. 3, 11, 15, 16, 17, 21, 27, 29, 37.

Code Justin., Lib. VIII., tit. XII., l. 22.

2d. Prohibition against magistrates who have not themselves assumed the cost of public buildings, inscribing their names thereon in place of that of the prince.

Code Theod., Lib. XV., tit. I., l. 31.

Code Justin., Lib. VIII., tit. XII , l 10.

3d. Obligation imposed on magistrates who commence buildings of public utility without authorization from the prince, to assure the completion at their own expense.

Code Theod., Lib. XV., tit. I., l. 28, 31.

[2] *Εις οικοδομιας δε πλειστας ανοφελεις τα δαμσια χραματα δαπανουν, τινα κατεσκευαςεν, α μικρον ὑύστεραν διελυετω, βε βαιδ δια τᾶν επειζιν ον γενομενα* (*Zos. hist., Lib. II.*, cap. xxxii.).

and the characteristics of that elegant school of Gaul, evident in the ruins of St. Remy, of Orange and of St. Chamas, are such true expressions of the kind of genius that is properly our own, that they are rediscovered intact in the edifices of our Renaissance.

Thus it was that the forms of architecture differed in the different provinces. There was the same diversity in the practical methods; Vitruvius affirms this when, treating of the manner of building cut-stone walls (Lib. II., cap. 8), he makes a clear distinction between the customs of the Grecian and Roman builders. Independently of his testimony, however, sufficient proof of this can be found in the monuments themselves. Often, in fact, we have had to call attention to certain types of construction, and particularly to types of vaults, that were centered about such and such a country, where they were in a certain measure limited and perpetuated, without spreading abroad or ever reaching the character of general types; these are so many indications of the distinct traditions, of the local variations.

For example, the vaults of juxtaposed arches seem to have been special to a very limited region of which the aqueduct of Gardes is the center; in this country the unbonded vaults abound, — their use is to a certain degree the rule, — while elsewhere but a few isolated and imperfect examples can be found, and that with difficulty.

The same observation can be made of the system of ribs supporting horizontal slabs by means of tympanums. The only examples known to me belong in two provinces, both almost Greek — Southern Gaul and Syria; in Syria the importance of the system is comparable only to that of the pointed arches of the western buildings in the middle ages.

The hypogea of the north and center of France, whose style and stonework we have already characterized, are also monuments of a special form of construction. (Pl. XVIII. and XIX.) At their aspect one is struck by the originality of the conception that distinguishes them both from the other Roman monuments and from the works posterior to the barbaric invasions. The rampant vaults of echeloned arches, the barrel vaults centered on temporary walls, the use of the keyed groined vaults that the other schools sought to avoid, the evidently systematic use of stone of small size in a country rich in large material, are all unusual circumstances that place these monuments in a well-defined group, where are announced the tendencies of our medieval architecture, and whose memory or example had influence at the rebirth of French art at the end of the Roman period.

These few examples, all taken from monuments of cut stone, indicate, for the present, the nature and importance of the differences that separated the contemporary schools; if, to complete the review of ancient methods, we go back to our descriptions of concrete vaults, divergences of the same order, or even more strongly marked, will be found.

Even the network of brick, which was used with such skill and success in Rome that one is tempted to think it an essential element of the art of building, even these never came into general use. It expressed the spirit of Roman construction better than any other thing, but on the whole it amounted only to a local practice, and becomes rarer and rarer as one goes away from Rome. It is only necessary to go from Rome to Pompeii in order to see a notable change in this respect; the armature in the form of a network is replaced by degrees by a continuous thick layer of tufa, covering the centering and supporting the vault.

Toward the north, in Verona, we will find vaults with armatures like those of Pompeii, except that rounded pebbles replace the tufa used where the soil is entirely formed of volcanic debris. And when the Alps are crossed, even the idea of an armature disappears; or else, by a curious reversal of rôles, the armature of converging strata increases in importance to the point of becoming by itself the vault, while the masses of concrete in horizontal layers are no more than a covering, a backing, or, in a word, an accessory; the functions of the parts are inverted.

Such were, in a special division of the art of building, and in a restricted portion of the empire, the variety of aspects presented by the methods of construction. Looked at from a more general point of view, antique art offers this same diversity of aspects in all its branches. If the types of sculpture, of Roman ceramics, of provincial medals, or even of the mosaics found in different parts of the empire, are reviewed, everywhere the mark of local schools will be found with the same clearness; everywhere a certain base of common principles will show the impulse emanating from Rome. But everywhere, under this apparent uniformity, attentive examination will discover shades without number, or even contrasts, in accordance with the entirely distinct municipal life of the ancient cities. Each city had its own architectural traditions, as it had its civil institutions, its customs, and its cult. Roman art was essentially municipal; this was its first, its principal characteristic. Let us then think of it in its innumerable forms, not trying to lend it a fixedness of methods incompatible with the incessantly changing conventions and necessities. Transplanted to diverse soils, it was subjected to inevitable influences; it transformed itself in order to spread over all the regions of the empire; its methods were classed by species; its types were consecrated by time, and each colony, each municipality, had in its corporations of artisans, depositaries of the traditions of local practice; and, as we will see, the Roman respect for the customs and freedoms of these labor associations contributed to rendering the distinctions between the different schools sharper and more durable.

(*Continued.*)

FIRE-PROOF BUILDINGS.

A PROPOSED change in the building law of Boston which has occasioned some discussion is that which requires that apartment houses of four or more suites shall be of first-class construction — that is, shall be built, both in their exterior and interior, of noncombustible materials. The objection that has been raised to this is that it is pushing the fire-proof theory to an unwarrantable length; but, it may be that those who look upon the question from this standpoint do so in ignorance of certain important considerations. In the first place, the cost of fire-proof construction has undergone in the last few years an enormous contraction. Some of the best builders assert that the difference in cost between fire-proof construction and ordinary construction is no more than between 10 and 20 per cent., and with the passage of the tariff bill and the increase that has been made in building timber, it is not impossible that the cost of first-class construction will be little, if any, greater than that of ordinary construction. A fire-proof building thus constructed, when once put up, has a durability which is worth, on account of the saving in depreciation, all of the added expense. In the matter of insurance, a decided reduction in rates can be obtained, and owners and occupants can have a sense of security which insurance either against fire, life, or accident will not altogether give to them. A still further fact is that this form of construction is what is required in practically all of the cities and towns of continental Europe, with the exception, perhaps, of Russia. Not only is it necessary in these places to build apartment houses and other large structures in this way, but the ordinary dwelling house is a fire-proof building. The result of this general adoption of correct methods of construction is seen in the almost entire absence of large losses by fire. Thus, in Berlin, which is a city about the size of New York, there are each year about the same number of alarms of fire as in the latter metropolis, say, between 3,500 and 4,000, or ten alarms a day. But although New York has a large and wonderfully well-equipped fire department, and Berlin a relatively small and seemingly poorly equipped defensive service, the fire losses in Berlin are not much larger on the average than those met with in such cities as Lawrence or Haverhill, while the losses in New York city, where this thorough system of fire-proof construction does not obtain, is each year from twenty to thirty times as great as it is in Berlin. The time has come to make a step forward in construction, and hence we trust that the suggestion of the building commissioner in the matter referred to will be favorably considered by the Legislature.— *Boston Herald.*

Fire-proofing Department.

DETAILS OF FIRE-PROOF CONSTRUCTION WITH BURNED CLAY.

BY PETER B. WIGHT.

COLUMN PROTECTION.

THE work of the fire-proofing experts in connection with columns, pillars, or posts is confined to the protection of iron or steel, and forms no part of the construction of a building. An exception to this can be found in the first tier of seventy-two columns forming the arcade of the United States Pension Building, at Washington, which are built of drums of fire-brick, with a 5 in. hole in the center. Wooden posts are supposed to take care of themselves, which is largely the case where hard oak is used. When disasters by fire, caused by the breaking of iron columns, became frequent and noticeable, a great cry was raised by the underwriters, experts, and some professional firemen that nothing was safe in any building except a large wooden post which would not snap off or bend, but would stand as long as enough of it remained to carry its load. It was long before this time that other investigators had called attention to the danger of iron columns in a fire, and had suggested the proper remedy. The most prominent authority to demand the use of wood in superseding cast iron was the late Captain Shaw, of the London Fire Brigade, and what he said was taken up and echoed all through our own country. Yet, years before he published his first book, Wm. Stratford Hogg, an Englishman, had, in 1862, taken out a patent for protecting iron columns from fire by building circular bricks around them and leaving an air space between. But he received no encouragement, and there is no record of his patent having been used. The result of this agitation was that in many buildings oak posts were used where it would have been better to employ iron protected by Hogg's method. This agitation led the writer to invent and patent, in 1873, a method of protecting cast iron by making the columns with four or more flanges, instead of in a cylindrical form, and securing gores of hard oak between them, depending upon the slow combustion of the surface of the wood, and its non-conducting properties when burning; for as a fact oak is a non-conductor of heat when one side is in combustion. The method was demonstrated by a comparative test with two unprotected iron columns in 1873. But while it attracted considerable attention, more on account of its novelty than its usefulness, the system was never put into use. It was not economical in the section of the iron used; yet no other form of casting could be employed that would admit of the application of the oak in a good form for protection. Fig. 1 shows how it was proposed to use this system, and its application to iron girders.

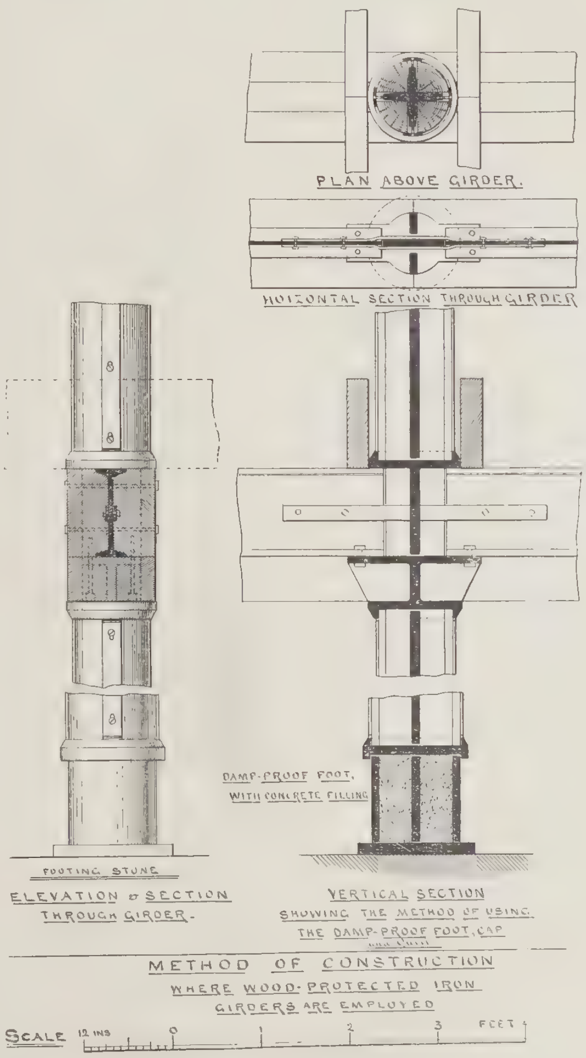


FIG. 1.

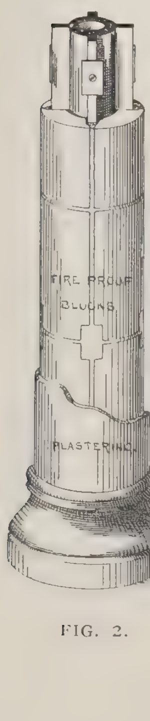


FIG. 2.

As porous terra-cotta was demonstrated to be a practicable article of manufacture in 1874, it was substituted for wood gores, and used for the first time with cast-iron cores of cruciform section in the Chicago Club, on Monroe Street, opposite the Palmer House in Chicago, now the Columbus Club. In these columns, of which there are four, the terra-cotta blocks project one inch beyond the flanges of the iron columns, and they are secured to the iron, not only by the cement, but by wrought-iron plates, 2½ ins. square countersunk into the tiles and screwed down to the edges of the flanges. The columns admitted of a plaster finish, and the ornamental capitals were of terra-cotta. Similar fire-proof columns were soon after used in the Milwaukee Board of Trade Building, some of which had six flanges in the iron cores. Five flange Phœnix wrought-iron columns were also used in the same building, and similarly fire-proofed.

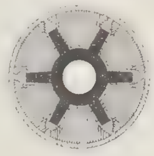


FIG. 3.

The next improvement in columns that were expected to finish twelve or more inches in diameter was to make the cast-iron cores in the form of a cylinder, with four or more projecting flanges of about 1½ ins. projection. This was found to require only a slight excess of metal over cylindrical castings of the same strength. The terra-cotta sections were made about 2½ ins. in thickness, and were secured to the iron by the same method as that used in the club house. These columns were used on a large scale in the retail store built by the late D. M. Ferry, on Woodward Avenue, Detroit, in 1879, and were used from that time up to about 1888, in such a large number of buildings that a computation then made showed that there were upwards of 40,000 lineal feet of columns thus fire-proofed. Fig. 2 is an illustration of one of these columns, and Fig. 3, a plan of one having six flanges as used in the First National Bank, Chicago. In 1884, this system came into extensive use as an application to the Phœnix wrought-iron columns. These are the same in practical shape as the cast-iron cores that had been used. Instead of screwing the countersunk plates into the edges of the flanges, cast plates were made with two hooks, which would fit over the rivet heads in any part. As the blocks were built up in place, a course of plates was hooked onto the rivet heads at about every two feet in height, and then built in with the next course of blocks. In this way all the Phœnix columns of the Mutual Life Insurance Building, on Nassau Street, in New York, were covered, most of them being six-flange columns. Fig. 4 is an illustration of the usual method applied to Phœnix columns, and Fig. 5 shows a special method applied to two columns in the Chicago Board of Trade. It was not uncommon, also,

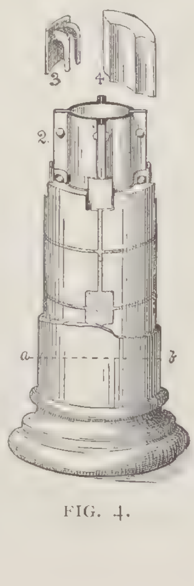


FIG. 4.

where it was desired to give square cast-iron posts a round finish, to make the blocks flat on the inside, and curved on the outside for this purpose. The countersunk plates were secured by screws to the outer angles of the castings, using them as if they were flanges. In the same way square cores were covered to finish square with chamfered angles (see Fig. 6), and even round columns were covered with porous terra-cotta blocks, so as to make them finish in a square form. For this purpose, and for the fire-proofing of cylindrical cast-iron cores that were not provided with vertical flanges, the castings were tapped with holes into which small, round studs were screwed, and the countersunk plates used to secure the fire-proof blocks were screwed into these studs (see Fig. 7).

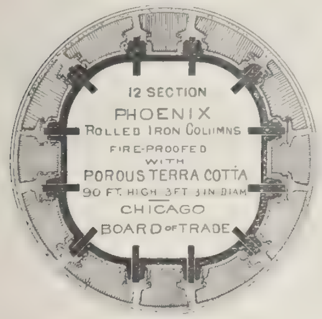


FIG. 5.

This system was based on the idea that no fire-proof material can be depended upon to hold itself in position, and that cement is only subsidiary to mechanical fastenings. It did not allow any fire-proof covering of an iron column to bulge off by vertical expansion, because it depended upon the individual fastening of the porous terra-cotta blocks to the iron core. This proved to be effective in every case in which it was tested. When the Grannis Block was burned in Chicago no attempt had been made to make it fire-proof in any particular, except that the cast-iron columns were covered as here described. But columns that had fallen down in the ruins were taken out with all their fire-proofing attached.

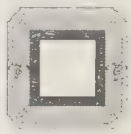


FIG. 6.

FIG. 7.

The engineers attached to the office of the supervising architect of the Treasury Department decided to fire-proof the columns of all buildings between 1880 and 1890. But they refused to allow them to be cast with flanges, and only allowed about 1 ½ ins. of thickness for the terra-cotta fire-proofing. As they would not permit the columns to be drilled, the fire-proofing had to be secured with bands. To put these on the outside, or to wire the blocks on, which the specifications allowed, would have exposed these fastenings to fire. Those which were done by the Wight Fire-proofing Company were covered with blocks having grooved edges. As each course was set, a hoop of iron was bent around the column, hooked together at the ends, and dropped into this groove. Then the next course was set with the grooved edge down, and thus the iron bands were incorporated with the tiles and cement, and protected from heat on the exterior. In this way the cast-iron columns of at least thirty government buildings were fire-proofed. Fig. 8 is an illustration of the method, and Fig. 9 a plan of one of these columns.

This is somewhat like writing up ancient history; for every one of the processes above mentioned has been out of use for from six to nine years. It is perhaps needless to add that they are the methods used for a long time by the company of which the writer was the originator, and which went out of business six years ago. The reasons for this are two. They are such as are not called for in the specifications, and sometimes more expensive than those in present use. It is part of its history that the Wight Fire-proofing Company, in the later years of its existence, followed in many cases the methods of its rivals in covering iron columns, for the simple reason that these were all that were called for and demanded in architects' specifications, or paid for by the owners. This was even the case in some of the largest government buildings. What seemed to become the standard system of fire-proofing columns at that time consisted of a flangeless unglazed hard drain tile, scored in two places so that it would split in two, and then set up around the column so as to break joints. In some cases the architect or superintendent would demand that they be tied on with wires, which was generally done when it was ordered, because it cost next to nothing, and it was not worth while to kick. An illustration of one of these is here given. (Fig. 10.) In other cases it has been customary to cover Z bar, or other kinds of built steel columns, with hollow blocks of hard, hollow tile, built as a wall around them and without fastenings, as was the case in the Horne Department Store at Pittsburgh, recently burned, and described in the June BRICKBUILDER. A few architects have required that the Z bar columns shall have their hollows filled in with pieces of tile before the exterior covering is put on. In other words, they think that the hollow tile covering is better when it is *stuck on* as well as built up. Such are the methods now generally used where tiles are employed, and hard or porous tiles are used indifferently according to whether the lowest bidder is a "hard" or "porous" manufacturer.

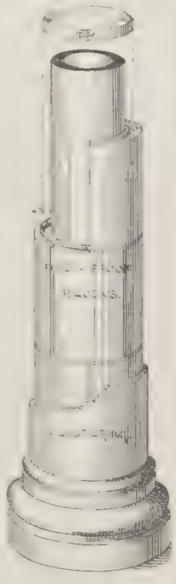


FIG. 8.

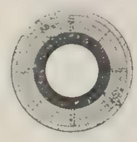


FIG. 9.

FIG. 10.

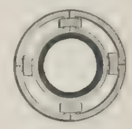


FIG. 11.

There is some food for reflection after reading the opinions of some of the most successful architects of New York and Boston, on the general character of our fire-proofing, in THE BRICKBUILDER for January and February. In the course of all of those interviews, which are characterized by very just criticisms of many of the shortcomings of the makers and users of clay fire-proofing materials, no suggestion was made of the necessity of *securing* the fire-proofing to the iron or steel by mechanical means. Those who referred to column fire-proofing only suggested increasing its thickness, and one said that it should be "at least" 4 ins. in thickness. Another suggested filling the columns solid with cement on the inside, and putting metal lathing and plastering on the outside. Mr. Carrère showed the most perfect knowledge of the defects and necessities of the fire-proofing art as practised in Eastern cities; but his only suggestions about column covering were that they should be heavier, interlocking, or that they should be doubled. The building law of Chicago, which was last amended so that it should cover also the use of plastic coverings with metal lathing, requires that there shall be two air spaces around all columns. THE BRICKBUILDER has already pointed out that the defective method, as in the Horne Department Store at Pittsburgh, which *by some good chance* left the columns intact though it fell off promiscuously, is admissible under its provisions.

So we find that in the present state of the art neither the laws nor the practise of the leading architects, nor the methods advertised by manufacturers or contractors,[1]

FIG. 12.

[1] The writer has looked in vain through the published catalogues of the present manufacturers of fire-proofing materials of clay for illustrations, or descriptions of methods for protecting iron or steel columns from fire, which provide for fastening the protection to the column, with the earnest hope to be able to do them justice, but has found none. Most of the illustrations given in them are unauthorized copies of some of the shapes that have been described in this paper, without the fastenings. Of those

are calculated to insure the safety of this most vulnerable feature of modern fire-proof buildings. We have traced a brief outline of the art as it has been practised,— necessarily brief, for very much more could be said on the subject. It does not show that the case is hopeless. It only demonstrates that we have much to learn that seems to have been forgotten. To sum up, it must be recognized that some method is better than others, and the best should be used. It is an unfortunate fact that the element of cheapness has been the main cause of depreciation, no less than the indifference of the architects. This is not to say that the effective fire-proofing of columns is a very expensive operation. On the contrary, there is very little difference in cost between good methods and bad ones, and this difference would hardly be noticed in the aggregate cost of a large and expensively finished fire-proof building, if attention is given to this detail at the proper time.

FIG. 13.

The writer was led into the field of fire-proof construction by his study of the best methods for protecting iron columns from fire. His first and every effort was to avoid any unnecessary additions to the diameters of columns. We have now become accustomed to these additions, and architects even propose to increase them. He found that porous terra-cotta was the best material for the purpose, because, on account of its own non-conducting properties, it did not require a hollow space. He also found by experiment and practise that a thickness of 2½ ins. of this material was sufficient under any circumstances, and that wherever it could be used it need not project beyond any flange more than 1 in. He became convinced that any fire-proofing material was liable to be forced away from the column by its own *lateral expansion in the direction of the length of the column*, and that it must be fastened directly to the column by mechanical means, countersunk for their own protection. These are the fundamental conditions of column fire-proofing, no matter how applied. They make it possible to save much space and yet get the best results. They are applicable to every form of vertical support now in use, and in applying them the best fire-proofing material ever made, porous terra-cotta, should always be used. The use of porous, and not semi-porous, material is recommended for inert or protecting material when used solid, while the semi-porous terra-cotta is recommended when used in the hollow form.

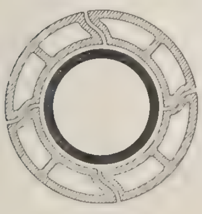


FIG. 14.

In making these suggestions much has been said that looks like advertising, and it must be added by way of explanation that all patents covering these methods have expired, and there is no monopoly of these ideas. THE BRICKBUILDER in publishing them is only doing missionary work in a cause which it is endeavoring to serve. We do not claim to be infallible, nor is the admission that there is always room for improvement a confession of the weakness of a cause. In this case it shows that the use of clay in the erection of fire-proof buildings is always capable of a higher development in the hands of those who are seeking for the best results.

OF all known fire-proofing materials, it has been unquestionably proven that burnt clay is the most effective for the prevention of the spread of fire. Where it has shown failure, faulty methods of application have been the cause. This is a matter that we may expect to see satisfactorily handled in the near future, as never before has it received the intelligent study that is being given it at present.

that appear to have merit and originality, the illustrations Figs. 11 and 12 show a plan and general view of one method of the Pioneer Fire-proof Construction Company, of Chicago, in which hollow tiles are held together *around* the column with cramps. Fig. 13 shows the method of the Illinois Terra-Cotta Lumber Company for protecting the Lorimer steel columns, and Fig. 14 shows the same method for cast-iron cylindrical columns. There is no description of these, but it has been noticed in practise that the blocks are built in courses breaking joints. Nearly every maker in the country makes for the Z bar columns either the ordinary partition tiles or hollow blocks similar to those used in the Horne Department Store and illustrated in BRICKBUILDER for June.

Mortar and Concrete.

LIME, HYDRAULIC CEMENT, MORTAR, AND CONCRETE. V.

BY CLIFFORD RICHARDSON.

THE MANUFACTURE OF NATURAL CEMENT.

FROM the preceding pages it is apparent that in the establishment of the natural cement industry at any point, a thorough study of the chemical composition and physical properties of the available rocks is necessary, in order to determine upon the selection of suitable material for the purpose and the rejection of that which is unsatisfactory. The proper manner of mixing and burning strata of different composition must be decided upon, and the economic considerations affecting the quarrying of different strata, depending on their dip and overburden, must, of course, not be neglected.

The following are the most important points to be considered in connection with the examination of hydraulic limestones: —

CHARACTER OF THE ROCK. The general appearance and nature of the various strata in any quarry of cement rock, their color, grain, and hardness, are usually somewhat different, and sufficient to distinguish and identify them. An examination in the laboratory, even with limited facilities, will then reveal definite physical and chemical properties which will enable one to determine the availability of the stone for the manufacture of cement.

PHYSICAL PROPERTIES. It is of the first importance that the rock should be dense. A light rock will not burn well or grind to a cement of suitable volume, weight, or density. The specific gravity determined at 78 degs. Fahr. should not be below 2.70, and should preferably be 2.8 or higher. Some hydraulic limestones have a specific gravity of only 2.65, and are inferior, while, where weathering has taken place, it may be even less. The best rock is always obtained after a quarry has been so far worked as to have reached beyond all weathered material and alteration products. Where the dip is sharp, this condition is soon arrived at; but when there is little dip, all strata must be rejected which are near enough the surface to have been weathered or acted upon by water.

In the Rosendale series of cement rocks the following densities at 78 degs. Fahr. were found for stone, all from deep levels, but at different depths.

Nearest Surface.	
Light rock,	2.830
Dark rock,	2.849
Medium.	
Light rock,	2.815
Dark rock,	2.841
Deepest.	
Light rock,	2.827
Dark rock,	2.845

At these depths below ground there is little difference in the density of the rocks obtained, all being very heavy and typical of the best quality.

The Fort Scott, Kansas, rock, on the other hand, which is nearer the surface, has a density of only 2.730; that at Round Top, Maryland, 2.731; while that of the hydraulic limestone of Illinois is no greater than 2.667, and of course does not produce as dense a cement.

The state of aggregation is as important as the density of a cement rock. The mixture of clay, sand, and carbonates should be

thorough, and one in which the constituents were deposited in the form of an impalpable powder. Where the sand is coarse, the clay in lumps, or the carbonates in pockets without admixture of silicates, the rock is unsuited for cement burning. Mere inspection will usually reveal the uniformity of the rock, while the size of the particles can be determined by dissolving a weighed fragment, without pulverizing, in acid, and determining the size and amount of the insoluble particles of sand remaining undissolved by means of fine sieves. As an example may be mentioned a magnesian limestone from a Virginia cement quarry, which might have made a fair cement were it not for the coarse nature of the stone. The residue of clay and sand, insoluble in acid, consisted of 9.5 per cent. of particles too large to pass an ordinary 100 mesh cement sieve. It was, therefore, necessary to reject this stratum in working the quarry.

In the Rosendale rocks the following residues were found in the cement rocks at various levels: —

		Per cent. of Residue on Sieve.		
		200 mesh.	100 mesh.	50 mesh.
Nearest Surface.				
	Light rock,	2.9		
	Dark rock,	0.0		
Medium.				
	Light rock,	0.0		
	Dark rock,	0.0		
Deepest.				
	Light rock,	0.6	0.6	0.4
	Dark rock,	1.2	0.5	0.3

On treatment with acids these rocks retained their original shape, but could then be broken down by a rubber pestle or the fingers, revealing, in one case, some firm silicious veins which were quite resistent. Under the microscope the fine residue has the appearance of kaolin.

Where it is necessary to use a coarse rock, the burning must be slow and prolonged, in order to bring about as much combination between the lime and silica as possible; otherwise, the finished product is merely one of quicklime and but partially combined silicates.

CHEMICAL COMPOSITIONS.

Carbonates of Lime and Magnesia. The amount of carbonates in a hydraulic limestone cannot exceed 75 per cent. and produce a good cement, and, in most cases, they should preferably be less than 70 per cent. Where several strata are taken from one quarry it is possible to use a small proportion of rock richer in carbonates. but this is undesirable on account of the difficulty of properly burning the richer limestone. The average composition of a mixture of rocks under such circumstances cannot exceed 70 per cent. without the production of an inferior or hot cement. With 75 per cent. of carbonate of lime the proportion for Portland cement is reached, and a different system of burning is necessary. The material from which Portland cement is made will, however, give a rock cement when lightly burned, but one that is very quick setting.

Hydraulic limestones, which are free from magnesia, probably make the best cements when properly proportioned. They must, however, contain sufficient clay. Such a stone has the composition given for the No. 2 rock of the Maryland quarry where the total carbonates are 68.44 per cent., including only 4.58 per cent. of carbonate of magnesia, while the silica and clay amount to 29.66 per cent. Rock of this description is rarely found. Where the latter constituents are deficient cement from such a rock is very quick and hot, especially when the rock contains more silicious sand than clay.

Magnesia. As has been already shown. the majority of the hydraulic limestones in use in the United States are magnesian, the amount of magnesian carbonate varying from 39 per cent. to little enough for the stone to be considered as a straight lime rock. In any single rock or mixture the carbonate of magnesia should not exceed 30 per cent., and should be preferably not more than 25. From a stone with more than the latter, the cement produced has a tendency to expand slowly with age, especially when deficient in clay. This is illustrated by a Western New York rock, having 37.0 per cent. of magnesian carbonate, and less than 11 per cent. of silica and silicates, which yields a cement which expands in concrete to a very large degree for many months or even years after use.

The Rosendale cements, owing to their density and composition, are the highest type of this class of cements. The rock they are made from contains only about 20 per cent. of magnesian carbonate, with 30 per cent. of clay.

Silica and Silicates. The amount of silica and silicates in hydraulic limestones is, of course, inversely proportional to that of the carbonates they contain. When rich in carbonates they are poor in silica and silicates, and the reverse. As it is to the presence of these substances that the limestones owe their hydraulic properties, the amount which they contain is of the greatest importance. It is also of quite as much importance that the silica should be largely, if not entirely, in combination with alumina as clay, and not in the free state as mere sand. This is determined by the amount of alumina and iron in the stone, which serves as an index of the possible clay present. For example, in a stone from Akron, N. Y., and one of the Rosendale series, the analyses previously given show 35 and 29 per cent. of substance insoluble in acid; but an examination of the amount of alumina and iron present reveals the fact that there can be but little clay in the Akron stone, while there is an abundance in the Rosendale, one having only 4.84 per cent. of alumina and iron while the other has 10 per cent. The Rosendale rock, in consequence, makes a very superior cement, while the Akron shows the peculiarities of a cement deficient in clay and too rich in magnesia. In fact, a deficiency in clay is more serious in a magnesian than in a lime cement, as under such circumstances there is very apt to be serious expansion of the cement after use.

Cement rock deficient in clay yields cements which heat and set too quickly. On the other hand, too much clay in a hydraulic limestone is as bad as too little. Cement made from such rock will blow or expand, when immersed in water, especially when carelessly burned. Clay may also contain too much iron oxide and insufficient alumina, in this case yielding a weak cement.

Sulphates and Sulphur. Sulphur occurs in limestone as sulphate of lime and as pyrites or iron sulphide. These substances are rarely present in sufficient amount to affect the quality of cements. Sulphates are sometimes reduced in burning, combining with some of the iron oxide to produce the green color now and then seen in briquettes of natural cement. Two per cent. of sulphur in its compounds is a large amount for a cement rock to hold.

Alkalies. Potash and soda are sometimes found to a considerable amount, between 1 and 2 per cent., in the silicates of hydraulic limestones. Unless they are present in more than the usual traces they have no effect on the cement. In excess they make the rock fusible in the kiln, in consequence of which such material is rejected or must be burned slowly at low temperatures. As far as is known, they do not injure the quality of the cement. The amount present in various well-known cements is as follows: —

ALKALIES IN HYDRAULIC CEMENTS.

Milwaukee	Cement,	K_2O	.87%
"	"	Na_2O	1.64
Ft. Scott	"	K_2O	.70
"	"	Na_2O	1.33
Akron, Star	"	K_2O	1.39
" "	"	Na_2O	.23
Akron, Obelisk	"	K_2O	1.60
" "	"	Na_2O	.52

Buffalo	Cement.	K_2O	1.44
"	"	Na_2O	.41
Rosendale	"	K_2O	
"	"	Na_2O	
Round Top	"	K_2O	
" "	"	Na_2O	

It will be noticed that in some cases potash is in excess, in others soda. This is due to the kind of feldspar from which the clay in the cement rock originated.

MINOR CONSTITUENTS. All limestones contain small portions, fractions of a per cent., of other elements besides those mentioned, such as barium, strontium, manganese, phosphoric acid, chlorine, and other widely diffused substances, but they have little or no influence on the suitability of the rocks for cement making, and may be neglected unless their amount is more than a trace.

CRUDE TESTS OF ROCK.

Where it is impossible to obtain complete chemical analyses and determinations of the physical properties, such as have been mentioned, a fair idea of the peculiarities and deficiencies of any hydraulic limestone may be obtained to supplement burning tests in the experimental kiln, or muffle, from an estimation of the loss on ignition. This corresponds to the amount of carbonates, and inversely to the per cent. of substances, insoluble in acid, present. From such a determination, especially when the appearance of the residue is examined critically with the object of learning its character, an approximate conclusion can be drawn as to the value of a stone or the cause of its inferiority.

In the simplest way an ordinary coal fire, in which pieces of the rock are buried and burned for varying lengths of time, will furnish much valuable information.

APPLICATION OF THE RESULTS OF ANALYSES TO PRACTISE.

As illustrations of the application of the information obtained from the physical and chemical examination of cement rocks to their selection and use in cement making the following cases in actual practise will serve.

QUARRY OF MAGNESIAN HYDRAULIC LIMESTONE.

Some years ago a new quarry of magnesian cement rock was opened in Maryland, which contained a large number of distinct strata which were available for making cement. I was requested, with due consideration for economical working, to select, after a chemical and physical examination, the best strata for use in making a high-grade natural cement.

The strata which were submitted were eleven in number, mostly of light color, and all, with one exception, quite uniform in character, but readily distinguished by their appearance. The results of the laboratory examination were as follows: —

ANALYSES OF MAGNESIUM LIMESTONE, MARYLAND CEMENT COMPANY.

No.	1	2	3	4	5	6
Loss on ignition	36.56	29.50	41.95	34.82	31.09	39.65
Silica	14.61	23.99	6.68	15.97	21.45	9.89
Alumina and Iron Insol.	3.83	5.60	2.03	4.54	4.01	2.77
" " " Sol.	2.49	4.17	1.58	3.05	2.86	2.73
Lime	25.25	20.16	31.59	23.72	23 87	28.63
Magnesia	16.18	13.33	15.81	15.64	12.98	15.15
Sulphur as SO_3	.78	1.29	trace	.71	.22	.34
Calcium carbonate	45.09	36.01	56.42	42.36	42.63	51.13
Magnesium carbonate	33.98	27.99	33.20	32.84	27.26	31.82
Total	79.07	64.00	89.62	75.20	69.89	82.05
	Poor		Bad	Poor		Bad
Silica, etc., coarser than 100 mesh screen	9.51	6.92	1.29	.04	.00	4.84

	7	8	9 Light	9 Dark	10	11
Loss on ignition	28.55	33.23	37.34	39.64	30.94	38.95
Silica	33.06	20.47	15.01	9.06	19.70	8.01
Alumina and Iron Insol.	3.26	5.09	3.22	4.84	4.84	2.63
" " " Sol.	3.26	2.67	5.22	2.51	5.09	1.59
Lime	20.33	26.20	25.85	27.88	20.25	39.77
Magnesia	10.26	11.59	18.84	15.67	15.23	7.43
Sulphur as SO_3	.82	.58	trace	.38	.34	.44
Calcium carbonate	36.31	46.79	46.17	49.79	36.16	71.03
Magnesium carbonate	21.55	24.34	39.56	32.91	31.98	15.60
Total	57.86	71.13	85.73	82.70	68.14	86.63
Silica, etc., coarser than 100 mesh screen	.32	1.31	.32	.00	2.02	.33

The rocks of the different strata in this quarry are distinguished in a general way by the rather low percentage of alumina and iron, and consequently of clay. The insoluble portion in many cases is largely silica, and rather coarse grained, as may be seen from the determinations of its size.

Stratum No. 1 was recommended for rejection, as it contained 9.5 per cent. of sand coarser than would pass the ordinary screen of 100 meshes to the inch. This rock was also too rich in carbonates, and would have given, under the best handling, an inferior cement, as magnesian cements deficient in clay are not constant in volume after use.

Stratum No. 2 had an excellent chemical composition but physically was too coarse, and, lying among inferior strata, it would naturally be neglected for economical reasons.

Stratum No. 3 was rejected because quite deficient in clay and silica.

Stratum No. 4 was characterized as a poor rock which might be used if necessary, but was not recommended, being deficient in clay.

Stratum No. 5 was marked as being a slight improvement over No. 4 owing to the smaller amount of carbonates it contained, although deficient in clay.

Stratum No. 6 was too rich in carbonates and too low in alumina or clay to be used for hydraulic cement.

Stratum No. 7 proved the most silicious of the series, although it contained little clay. With care in burning it could be used, as the silica was present in a state of fine division. It is, however, not an entirely satisfactory rock.

Stratum No. 8 proved a good stone for this quarry.

Stratum No. 9, in both its forms, light and dark, was, besides having great lack of uniformity, too rich in carbonates and deficient in insoluble matter. By itself this stratum would prove a poor one.

Stratum No. 10 was an excellent one, and was recommended for use.

Stratum No. 11 appeared at a glance to be insufficiently hydraulic, and was excluded.

Of all these strata, for one or more reasons, only those numbered 5, 8, and 10 were considered to be fairly good rock, if burned by themselves. The possibility, however, of mixing the cement made from the different strata permits the faults of one to correct those of another to a certain extent. The stratum No. 7 was, therefore, included, and such a mixture served very well. Cement so prepared analyzed as follows: —

Loss on ignition	8.29
Uncombined silica	16.30
Silica combined	13.50
Alumina and iron oxide	11.04
Lime	33.36
Magnesia	15.58
Sulphuric acid	.40
Alkalies	1.50

The proportions of silica, clay, and carbonates are satisfactory in this mixture, and gave a good cement which, it would seem, might perhaps have been improved by some further slow burning, as too much of the silica was in the uncombined form. As a matter of fact, however, rock from this quarry in practise had to be burned lightly

and with great care to obtain the best results, and for this reason considerable silica was left uncombined. The cement has proved, after long use, to be a satisfactory and permanent one, although probably not one of the best.

QUARRY OF MAGNESIÁN FREE CEMENT ROCK.

In another Maryland quarry, where the rock was as nearly free from magnesian carbonate as ever happens, an opportunity occurred for a study of the variations in composition of a large number of strata, and of the suitability of this kind of hydraulic limestone for cement making. The strata had a dip of nearly 90 degs., and, being exposed along the face of a high cliff, were, in consequence, very accessible.

The rocks, fifteen in number, had the following composition and furnished, when burned by themselves, experimental cements which set and tested as given.

COMPOSITION OF THE STRATA OF ROCK AND TESTS OF THE CEMENT BURNED THEREFROM IN A MARYLAND QUARRY, MAY–JUNE, 1892.

No.	1	2	3	4	5
Silica	28.08	20.40	28.72	26.36	16.38
Alumina	12.58	12.42	12.28	10.88	8.42
Iron	5.00	4.86	5.22	5.50	2.86
Calcium carbonate	45.86	57.93	43.82	48.75	62.56
Magnesium carbonate	2.18	2.98	2.31	2.85	5.76
Total carbonate	46.04	60.91	46.13	51.60	68.32
Total aluminum and iron oxide	17.58	17.28	17.50	16.38	11.28
Sulphur	.00	1.18	1.53	1.73	.67
Total silica and silicates	45.66	44.68	46.22	37.24	27.66
Set initial	30 ft.	10 ft.	65 ft.	7 ft.	26 ft.
Tensile strength.					
1 day neat	36	83	64	60	64
7 " "	64	212	252	190	218
28 " "	152	275	252	276	307
3 months.					
7 days 2 parts quartz	46	122	184	168	127
28 "	110	250	210	206	233

	6	7	8	9	10
Silica	21.94	9.92	12.12	21.78	29.22
Alumina	7.96	3.38	2.36	5.57	11.48
Iron oxide	3.78	2.22	3.78	3.82	3.52
Calcium carbonate	60.75	81.52	51.82	61.40	44.57
Magnesium carbonate	2.01	1.07	23.39	3.15	3.86
Total carbonate	62.76	83.49	75.21	64.55	48.43
Alumina and iron oxide	11.74	5.60	6.14	9.39	15.00
Sulphur	.34	.11	.00	1.10	.78
Total silica and silicates	33.68	15.52	18.26	31.17	44.22
Set initial	32 ft.			48 ft.	14 ft.
Tensile strength.					
1 day neat	61			48	54
7 " "	218			220	225
28 " "	210			262	220
3 months.					
7 days, 2 parts quartz	152			187	165
28 "	240			239	268

No.	11	12	13	14	15
Silica	16.82	18.50	35.38	8.78	42.94
Alumina	5.46	6.34	13.46	2.70	12.62
Iron	3.66	4.28	4.28	2.62	5.92
Calcium carbonate	69.54	43.03	33.61	80.39	25.56
Magnesium carbonate	2.69	16.00	7.56	4.02	8.35
Total carbonate	72.23	59.03	41.17	84.41	33.91
Total aluminum and iron oxide	9.12	10.62	17.74	5.32	18.54
Sulphur	.80	.35	.82	.64	.17
Total silica and silicates	25.94	39.12	53.12	14.10	61.48
Set initial	4 ft.	14 ft.			

Tensile strength.

1 day neat	128	62
7 " "	250	138
28 " "	266	300
7 days, 2 parts quartz	233	80
28 "	285	190

These hydraulic limestones are very typical of cement rock which is free from magnesia. They show quite as marked variations in composition as those of any quarry that has been examined, having from 84 to 34 per cent. of carbonates containing from 23 to 2 per cent. of carbonate of magnesia, with from 61 to 14 per cent. of silica, alumina, and iron oxide, and from 1.73 to 0 per cent. of sulphur as sulphates. Physically the rocks were of very fine texture, as only one, No. 5, left particles too coarse to pass a sieve of 100 meshes to the linear inch on solution in acid, in this respect being very different from those of the magnesian quarry previously described. Of all the rocks it is at once evident that Nos. 7, 8, 13, 14, and 15 must be rejected, 7, 8, and 14 on account of their excess of carbonates and deficiency in clay, and Nos. 13 and 15 for the opposite reason. Stratum No. 8 would, however, furnish a cement of the Western New York class.

Of the other strata, cements were burned in an experimental kiln and tested, with the results given. The remarkable fact that good, natural hydraulic cement could be made from rock of such very varied composition is very striking.

The group of strata 1, 2, 3, and 4 are all very high in alumina and iron, consequently of clay. Nos. 2 and 4 are in addition the highest of these in lime, and consequently yield the quickest setting cements. No. 3, having the least lime, is the slowest setting. With the high percentage of clay which these limestones hold their burning must be conducted carefully, or blowing cement would result.

Strata 5, 6, and 9 are lower in clay and higher in lime than those preceding, and furnish slower and more satisfactory cements. No. 10 resembles the highly clayed rocks 1 to 4. No. 11 is so rich in lime and poor in clay as to make a fiery cement, and No. 13 is, as we have mentioned, rejected on account of its magnesia.

We found, then, in this quarry two particular classes of rock, one highly clayed, the other much less so. This fact and the economy of working the strata led to the decision to burn the strata 2, 3, and 4, as one lead in the quarry, in one set of kilns, and numbers 9 and 11 as another lead in another set of kilns, mixing the burned rock before grinding. If an increased output was desired, it was suggested that Nos. 5 and 6 be added in the second series, or No. 12 omitted and these used in its place.

With these suggestions as a guide the works were established, and a high-grade cement made after some experimenting as to the best manner of burning.

The physical properties of the cements made from the different rocks of this quarry are instructive. The high lime and low-clayed rock, No. 11, made a cement which gave the greatest immediate returns, both in quickness of set and in tensile strength, of any of the strata. It must be noticed, however, that, having acquired this strength quickly, there was little or no increase at a later period. This is very characteristic of such cement.

The magnesia rock, No. 12, gained in strength slowly, as all magnesia cements do, but would in the end have probably exceeded many of the others. As it was, it surpassed in neat strength all but one at 28 days. If used for the manufacture of cement, it would probably have to be burned in a different way from the other strata, to obtain the best results.

Strata Nos. 1 and 4, which are nearly identical in composition, yielded cement of quite different quality, No. 1 being the weakest of all that were burned. This can only be attributed to a difference in the manner of burning. It is probable that No. 1 was either under or overburned.

The cements from the other strata were much alike in tensile strength.

The Masons' Department.

STRAINS IN ARCHES. III.

BY JOSEPH MARSHALL.

IF we now apply to the method pointed out in the foregoing chapters the test of the "resolution of forces," we will have a fair comparison, and may judge whether the foregoing methods are sufficiently approximate in their results to be considered worthy of adoption in practise.

Referring to Fig. 10, which is drawn to a scale of ⅛ in. to the foot (reduced one half in reproduction), we have the heavy line B to *a* indicating the pier supporting an arch indicated by the heavy lined arc *a* to *v*, which is intersected at *c'* by the neutral line *o n* drawn at 45 degs. elevation.

Assuming that the arch is 1 ft. by 1 ft. sectional area, and that the weight of that part of the arch above the neutral line is (in even hundreds) 2,000 lbs., and that part below the neutral line also 2,000 lbs., we have the diagonal line *c'v* indicating a force of 2,000 lbs. in the direction towards *c'*. Resolving this into two equivalent forces,—one acting horizontally, the other vertically,—we have the parallelogram *c'* H *v w*, which in their magnitude and direction are equal to *c' v*. If *c' w* with its indicated force acted from *c'* towards *w*, and *c'* H also with its indicated force acted towards H, they would conjointly exactly balance the 2,000 lbs. indicated of *c' v*.

Then for the force and direction of the lower part of the arch we have the parallelogram *c' a' a l* with the diagonal *l a'* indicating a magnitude of 2,000 lbs. force, with its equivalents *l a* vertically and *l c'* horizontally. The forces indicated by the horizontal lines *l c'* and *c'* H act in opposite directions and in the same straight line, and, therefore, are to each other as the algebraical differences of their magnitudes. If they were of equal magnitude they would exactly balance each other. But they are not equal in magnitude, and hence one must be greater than the other—*c'* H, indicating the thrust, is the greater, and *l c'*, indicating the counterthrust, the lesser. Beyond establishing the relations and magnitude of the forces in the arch the employment of the parallelogram of force is useless, because the excess of force, whatever it may be or in whatever direction acting, acts upon the pier at *l* and in manner to convert the pier into a lever of the length *l B*. Having discovered the difference in magnitude between the thrust and counterthrust, and knowing the length of the lever *l B*, nothing remains but to proceed with the numerical calculation as in Chapter II. The diagonal line *c' v* being charged with representing 2,000 lbs. force, and choosing the scale of one eighth of an inch for 125 lbs. (convenience dictating),

we have *c'* to H equal to	14¾	eighths, and
from *l* to *c'* equal to	6¼	eighths.
Subtracting, we have	8½	eighths thrust
× 125 lbs. to each eighth	125	
Gives excess of thrust at *l*	1062½ lbs.	
× by length in feet of lever *l B*	44¾	
Excess of thrust force at *B*	47547 lbs.	

This must be counterpoised by:

÷ weight of half arch	4000 lbs.
plus weight of pier, 30 ft. by 121¼ lbs. weight per cubic feet	3637
Total counterpoise weight in pounds	7637)45822(6 ft.
	1725
	×12 for ins.
	20700 (2 ins.
	15274
	5426/7637 = ¾ nearly.

Or 6 ft. 2¾ ins., nearly, for the length of the bent arm of the lever from B towards *x*. In our numerical calculation in Chapter II. we found the requirement at this point to be 6 ft. 4½ ins., or 1¾ ins. more than by the present calculation.

It is now expedient that we inquire into the necessary length of the lever arm at *a*, the springing line of the arch.

We have, of course, the same excess of thrust force indicated above, but the counterpoise weight is reduced to the weight of the half arch only, and the length of lever is only from *l* to *a*, 14¾ ft.

Hence we have:—

Excess of thrust at *l*	1062½ lbs.
× length of lever *l* to *a* in feet	14¾ ft.
Thrust force at *a* (omitting notice of fraction)	15672 lbs.
÷ weight of half arch in pounds	4000)12000(3 ft.
	3672
	× 12 for ins.
	44064 (11 ins.
	44000

or the bent arm of the lever *l a* extending towards *b* is shown to be required to be 3 ft. 11 ins.,—the fraction is worthless.

In numerical calculation in Chapter II., this arm is shown to be 4 ft. 3¼ ins.; there is then a difference between the two results of 1¾ ins. for the arch when mounted on piers 30 ft. high, and 9¼ ins. when the arch rests on its springing. The question will at once arise why this difference—even small as it is—why does it appear?

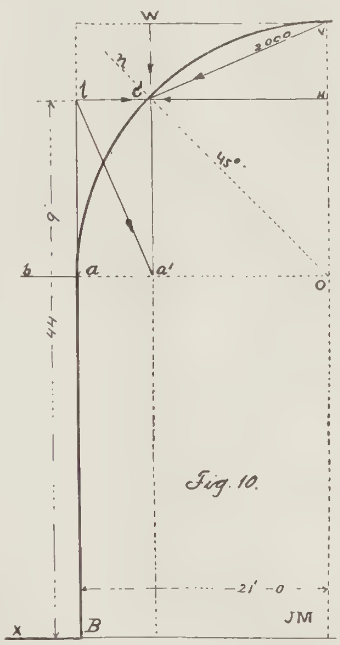


Fig. 10.

In answer we will say that in the method shown by Chapter II., the fixing of the length of the lever through which the counterthrust force operates is somewhat arbitrary, as is also the counterthrust force itself. But, although arbitrary, convenience is served by it and the degree of accuracy quite sufficient for practical use. Limited space herein forbids more extensive explanation and observations upon this very important subject,—conditions which may in the future be otherwise removed,—but it is necessary here to observe, as a cautionary advice, that the dimensions of pier required to support a given arch are not safely ascertained by drawing a straight from the indicated requirement at the nether base of the pier, as at *x*, to the indicated requirement at the spring line of the arch, as at *b*. The exterior boundary line of such a pier would be invariably *convex* outwardly. The manner of ascertaining the proper degree of convexity in any required pier is to divide the height of the pier into any desirable number of parts—equal or unequal—and to consider the lines of division as so many different bases, and find the extent of the horizontal arm for each base separately, then trace the line of curvature between the indicated points. It is not necessary that the permanent face of the pier shall remain possessed of this curvature, but only that such curve be regarded as a cautionary signal to the designer, perhaps disappearing when the final dimensions are reduced to consonance, with the judgment and intentions of the designer.

Before closing this communication we beg to be permitted one remark concerning something like advice, given to us by so many authorities commenting on arches as structural factors. I mean the importance which seems to be attached to the "depth of the keystone." From this, some pleasant fictions seem to have been romanticated as to the size of the voussoirs or archstones. Those authors, quoting from arches which, it seems, have been structurally successful, have laid down quite lengthy tables of the depths of keystones, and we are expected to take this advice as a fish might take a bait and swallow it. If the structure, based on this advice, is a success, we congratulate ourselves; if it fails, we, in part, excuse ourselves on

the score of precedent, and partly because of the alleged "dishonesty of the contractor," the "incapacity of the workmen," "treachery of the foundation," or some other ingenious fabrication.

The relation of keystones to voussoirs, or archstones, is this: They must not be of less depth than their next neighbor archstones, or such masses as may be employed to serve as archstones. If we take this view of it, there still remains importuning us for an answer the question, What should be the depth of the arch blocks, and how shall we determine this for any required instance?

We should approach the reply in this way: —

1. The weight the arch is to bear (the weight of its own mass included) as compared with the resistence to crushing which the material of which the arch is built possesses: in the same manner as the crushing strength of a vertical pier or wall is considered and determined; for, after all, an arch is only a wall or pier built more or less parallel to the horizon, instead of perpendicular to it.

2. By considering convenience as regards the conventionally or accidentally fixed masses of materials of which some arches are, and others may be built, such as brick, rough stones from the quarry, building tile, etc., etc., and then allowing reasonably for defections in materials and workmanship, — and "there are others."

By far the greatest number of arches are built stronger than the demands of their position are ever likely to require, and this because we do not care to reduce materials to exact dimensions that we may know to be necessary. We take such as we find ready to hand which will serve. This is true particularly of all arches of little span and bearing little weight.

It is only when we have the shaping of the material, both as to dimension and form, subject to our judgment and order that the question seriously presents itself, How much *must* we have? or, How little can we with safety employ? Then the suggestion 1 above becomes pertinent.

But in any event the *strength* of the arch is not ascertainable from a made-for-stock "keystone." It is better to make the keystone to suit the arch requirements; *i. e.*, if a "keystone" is at all permissible as an especially honored or conspicuous member of the brotherhood composing the arch. Of course we find the center and highest part of an arch a most tempting (because of precedent) place on which to hang the conceits we call "ornaments" or "decoration," and for this reason we often go a great way around to mask our purpose.

And when it happens that our purposes are a long time masked, superstition, like a spider, weaves many fantastic webs around them, so as finally to effectually conceal the underlying motive or render a correct interpretation almost impossible. For these reasons we wander sometimes long amid a labyrinth of uncertainties, making pursuit after many will-o'-the-wisps, but not readily finding our way out.

Another curious quandary we often find uneasily brooding. In form of question it is: WHAT RISE SHOULD AN ARCH HAVE? The popular mind is full of the idea that an arch, to be "strong," must have relatively great height above the tops of its piers. But this, like many other popular ideas, is a fallacy. But the arch with a great rise above its springing is more easily destroyed than a popular fallacy.

The least *rise* an arch has, when its supports are competent, the stronger the structure will be. Then the question propounded above must of necessity change its form and become, What is the least rise sufficient for full structural efficiency in an arch?

We would answer that the least rise must not be less than the equivalent of *compression* under the greatest weight to be borne.

Taking it for granted that some curve may be traced through component parts of an arch, it follows that the arc is longer than a straight from one extremity of the arc to the other. It is self-evident that the longer line would not pass through the space occupied by the shorter one. Therefore the arch could not drop through the void it spans. But if by any means the length of the arc be shortened to a length less than the straight line between its extremities, then it will readily drop into the void. This, it seems to us, is the whole essence of the philosophy involved in the relation between the rise and span of an arch.

Recent Brick and Terra-Cotta Work in American Cities, and Manufacturers' Department.

NEW YORK. — A state of midsummer quietness seems to be prevalent in this city, but it is no more than should be expected, and is not an alarming condition of affairs. On the contrary, the outlook for the coming fall and winter is very bright, and even the architects, who are not busy now, seem to be sanguine as to the future and what it will bring forth. There seems to be no reason why this city should not share in the good times which are sure to follow, with the tariff law settled and confidence restored.

The coming election for the first mayor of Greater New York will undoubtedly cause considerable excitement, and possibly some interference with business; but this will be counteracted by the feeling everywhere prevalent that the city will be benefited ultimately by consolidation.

Among the items of new work which have been reported are: —

A five-story brick and stone tenement at Nos. 104 to 106 Second Street, for Mrs. Van Alen, of Newport, R. I. Clinton & Russell are the architects.

An office building to cost $125,000, designed by C. P. H. Gilbert, architect, will be erected on the northeast corner of Broadway

TERRA-COTTA DETAIL, BUILDING FOR THE EVANS ESTATE, BUFFALO, N. Y.
E. A. Kent, Architect.
Executed by the Northwestern Terra-Cotta Company.

and Maiden Lane. It is interesting as showing the enormous value of real estate in this locality to note that this lot 30 by 50 ft., with the old five-story building which is now on it, was sold for $245,000.

R. Maynicke, architect, has planned a $250,000 office building to be erected on Broadway for Henry Korn.

McKim, Mead & White, architects, are making extensive alterations to the residence of ex-Secretary of the navy, Wm. C. Whitney. It is said that the alterations will cost $150,000.

Mr. Oliver H. P. Belmont has purchased a lot on the southeast corner of Fifth Avenue and 77th Street, for which he paid $150,000. The lot is 27 by 120 ft. Mr. Belmont intends to erect a handsome residence, but plans have not yet been prepared.

A. M. Welch, architect, has filed plans for one three-story and three two-story brick and stone stables and dwellings on 77th Street. Cost, $60,000.

H. J. Hardenburgh, architect, has drawn plans for a hotel to be erected at 54 and 58 Third Avenue. Cost, $400,000.

Dehli & Howard, architects, have planned an academy of music for the Apollo Club, of Brooklyn, to cost $600,000. The site has not yet been selected.

Buchman & Diesler, architects, have completed plans for a twelve-story store and loft building, to be erected on Broadway, between Prince and Houston Streets, and to cost $800,000.

CHICAGO.— Bids on anything in the building line can be obtained at remarkably low figures. Contractors who formerly awaited invitations are now soliciting opportunities to figure. There is, however, a brighter feeling, and building is on the increase, though the increase is slow. As the political economist would term it, the improvement is a conservative, healthy one.

RESIDENCE AT MADISON, N. J.
Clinton & Russell, Architects.

We repeat ourselves, as the facts are doing, when we say that the greatest part of the building activity is in small flat buildings, which can be seen springing up even in the outlying districts of Chicago. The greater number of these cost from \$7,000 to \$12,000 or \$15,000. One, costing \$35,000, may head the column of building news, while \$75,000 to \$100,000 figures often get extended description.

Alterations of stores and commercial buildings have been referred to as an important feature of building operations in this city this year. The remodeling of one hotel is just being completed, and that of three more well-known hostelries will soon be under way, under the direction respectively of Jenney & Mundie, Wilson & Marshall, and W. W. Boyington & Co.

Holabird & Roche have let contracts for a commercial building, seven stories high, to be erected near the new public library.

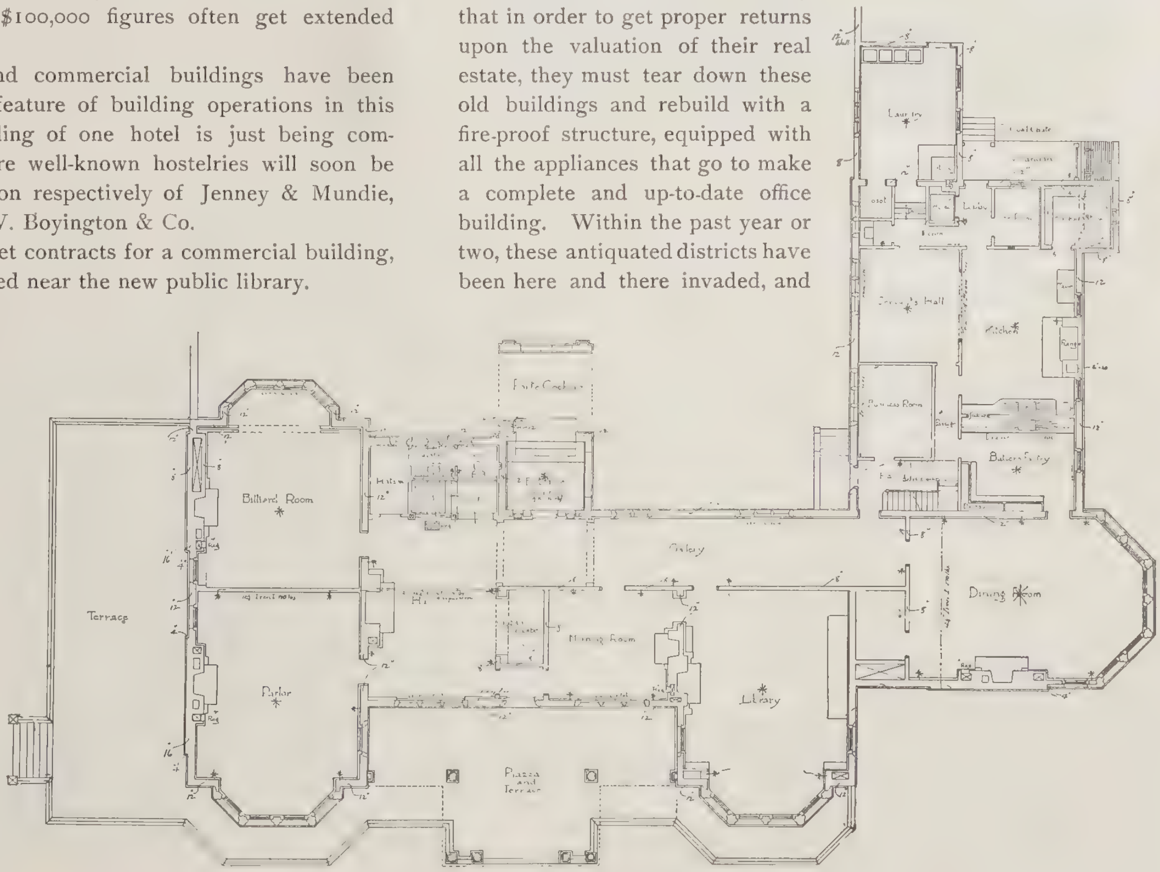
The one building project which interests the general public in Chicago is the Post-Office Building. The old one did finally disappear, and now the site is a desert waste — a lonely looking excavation a block square, surrounded by a dense business population. A contract has just been let, however, to McArthur Brothers, some \$235,000 in amount for foundation work, and they will begin soon to drive piles.

The old post-office had continuous foundations of heavy concrete so well built that they had to be blasted out. They rested on a bog, however, and the unequal loading caused serious trouble. The foundations of the new building are not to be of the isolated type, but, like those of the public library, where the consulting engineer was the same, Mr. Sooy Smith, will be piles. They are to be of Norway pine, and the contract requires that they be driven to bed rock 103 ft. below the street level.

Some two hundred thousand, more or less, Chicago bicyclers are beginning to pay their \$1 each for license tags, in pursuance of a recent ordinance. The architects have not as yet begun to pay their \$50 apiece for their license tags, in accordance with the new State law.

The Pioneer Fire-proof Construction Company lately lost one of their factories by fire. This may have been a satirical joke on the part of the little red devils, but we are pleased to know that the company's business will not be seriously interfered with.

BOSTON.—While there is not a great deal in sight at the present time in the way of new building operations, yet there is every reason to believe that Boston is on the eve of a very active period in this respect. Real estate owners are beginning to feel the demand on the part of their tenants for better accommodations, and the old-time buildings are fast being vacated because of the decided preference given to modern structures by the majority of business men renting offices. It is doubtful if any of the other large cities have as large a proportion of antiquated buildings located on valuable business sites as has Boston. The commercial heart of the city is largely made up of just such structures, varying in age from forty years upward. It is now becoming evident to the owners of such property that in order to get proper returns upon the valuation of their real estate, they must tear down these old buildings and rebuild with a fire-proof structure, equipped with all the appliances that go to make a complete and up-to-date office building. Within the past year or two, these antiquated districts have been here and there invaded, and



FIRST FLOOR PLAN, RESIDENCE AT MADISON, N. J.
Clinton & Russell, Architects.

modern buildings of attractive appearance have been, or are now being erected, which, by force of contrast, make the old structures

RESIDENCE, WOODLAWN AVE., COLUMBUS, OHIO.
H. A. Linthwaite, Architect.
Built of Gray Roman Brick, manufactured by the Columbus Brick & Terra-Cotta Company.

less desirable than ever. The effect of this will, we believe, be soon evinced by a general rebuilding of these localities, especially now that the improvement in business conditions warrants investors in going ahead with enterprises of this nature.

The erection of the South Union Terminal Station along the lines of Summer and Federal Streets greatly increases the valuation of property in that section, and, to some extent at least, will alter the character of business on the streets mentioned, and also in the immediate neighborhood of the station. Owners of real estate on the line of Summer Street anticipate that their properties will become valuable sites for retail establishments, and should this prove true, it will cause, within the next few years, a general rebuilding of that street.

Work on the station itself is rapidly progressing, and notwithstanding the many unforeseen obstacles encountered, the contractors are already ahead of their contract. Superintendent Clark states that they will doubtless begin to lay front brick on the main building at the Summer Street corner by the middle of September. Unless something unforeseen occurs, there is little doubt but that the station will be ready for occupancy by the fall of 1898.

Among the new buildings, either now under process of construction, or on which work will be shortly begun, may be mentioned the following: —

The Jeweller's Exchange (office and retail store building) situated at the corner of Bromfield and Washington Streets, Winslow & Wetherell, architects; Fuller Construction Company, of Chicago, contractors; to be constructed of brick and terra-cotta. The Russia Building (mercantile), Atlantic Avenue and Congress Streets, Peabody & Stearns, architects; C. Everett Clark, contractor; to be constructed of brick. Converse Building (office building), Pearl and Milk Streets, Winslow & Wetherell, architects; L. P. Soule & Son, contractors; to be constructed of brick and terra-cotta. Paul Revere School Building, Peabody & Stearns, architects; W. S. Sampson & Son, contractors; to be constructed of mottled brick and gray terra-cotta. Bath-house for the city of Boston, Peabody & Stearns, architects, James Fagan, contractor; to be constructed of mottled brick and gray terra-cotta. Brookline Real Estate Trust Building (a $250,000 fire-proof apartment hotel) at Brookline, Winslow & Wetherell, architects; T. S. Robbins, Worcester, Mass., contractor; to be constructed of brick and terra-cotta. St. John Parish Church, East Boston, Martin & Hall, architects, Providence, R. I.; W. L. Clark & Co., contractors; to be constructed of brick and terra-cotta. Cambridge Savings Bank Building, Cambridge, Mass., C. H. Blackall, architect; Norcross & Cleveland, contractors; to be constructed of brick and terra-cotta. Puffer Building (mercantile), Harrison Avenue and Essex Street, Rand & Taylor, Kendall & Stevens, architects; to be constructed of terra-cotta and limestone. Solid terra-cotta front above the second story. Masonic Temple, Boylston and Tremont Streets, Loring & Phipps, architects. Fire-proof building; to be constructed of brick. $200,000 apartment hotel, Brookline, Mass., E. D. Ryerson, architect; to be constructed of brick and stone. $630,000 apartment block, Back Bay, Henry E. Grieger and John Addison, architects, Chicago; to be constructed of brick and terra-cotta. Residence for Earnest W. Bowditch, at Milton, Mass., architects, McKim, Mead & White; C. Everett Clark, contractor; to be constructed of brick. $150,000 dormitory, Cambridge, Mass., Coolidge & Wright, architects; to be constructed of brick; fire-proof building. $120,000 apartment hotel, Back Bay, Charles E. Park, architect; to be constructed of brick. $60,000 schoolhouse, Somerville, Mass., Aaron H. Gould, architect; to be constructed of brick. $130,000 apartment hotel, Back Bay, H. B. Ball, architect; to be constructed of brick. $500,000 office building, corner Somerset and Beacon Streets, Boston; Congregational Publishing Club, owners; Shepley, Rutan & Coolidge, architects; to be constructed of stone. New brewery for the Puritan Brewing Company, Charlestown, Mass., Hettinger & Hartman, archi-

BRICK AND TERRA-COTTA RESIDENCE, PITTSBURG, PA.
Beezer Bros., Architects.

tects; Mack Brothers, of Salem, contractors; to be constructed of red brick. $150,000 addition to the Insane Hospital, at Worcester, Mass., Fuller, Delano & Frost, architects, Worcester; to be constructed of

CARTOUCHE PANEL, NEW YORK AND NEW JERSEY TELEPHONE BUILDING, BROOKLYN, NEW YORK.
R. L. Daus, Architect.
Executed by the Perth Amboy Terra-Cotta Company.

brick and stone. $30,000 church, Exeter, N. H., Cram, Wentworth & Goodhue, architects. Revere town hall, Revere, Mass., Greenleaf & Cobb, architects; W. L. Clark & Co., contractors; to be constructed of red brick and gray terra-cotta.

ST. LOUIS.— The report of the Commissioner of Public Buildings for the last month shows an increase in the number of permits issued, and also for a better class of buildings. This, for one of the dullest months in the year, affords considerable encouragement, and the feeling seems quite general that there will be a steady improvement in business throughout the year.

The most important happening in this part of the architectural world of late, perhaps, has been the competition for the St. Louis Club. A short time ago the club, becoming dissatisfied with their present location at 29th and Locust Streets, which is a most interesting piece of Romanesque work, by Peabody & Stearns, selected a site on Lindell Boulevard, which extends through to Olive Street.

Architects Eames & Young, M. P. McArdle, and Shepley, Rutan & Coolidge, of this city, and Arthur J. Dillon, of New York, were invited to submit plans, and Mr. Dillon's plans were selected. The design is in the French Renaissance, two story and attic high. On Olive Street an entrance and gate lodge will add to the attractiveness of the surroundings. Some comment has been made concerning the action of the committee in selecting Mr. Dillon's plans, as 'tis said the instructions were that the building should be designed in the Italian Renaissance, but it seems by the employment of the French style, and the placing of the banquet hall in the high roof, the architect was enabled to get the required amount of space with a very much reduced cubic area, which, doubtless, influenced the committee very materially in their decision. The building is expected to cost between $125,000 and $150,000.

During the past three years quite a number of schemes have been in contemplation for the improvement of the northeast corner of Olive and Sixth Streets, which have taken more or less definite form, but eventually fell through, and the last proposition, which was to build a sixteen-story office building, and for which a permit was taken out before the ordinance, limiting the height of buildings, went into effect, seems to have shared the fate of all others after the old buildings had been partially wrecked.

Shepley, Rutan & Coolidge are preparing plans for a nine-story fire-proof building, to be built on the southeast corner of St. Charles and Tenth Streets, for the Imperial Lighting Company. The lower floors are to be used for the machinery, and the upper floors for offices.

TERRA-COTTA PANEL, RESIDENCE, BROAD STREET, PHILADELPHIA, PA.
Hazelhurst & Huckel, Architects.
Executed by the Conkling, Armstrong Terra-Cotta Company.

PITTSBURG.—Activity in the building line has been very brisk the past month, and much more work is looked for in the near future. Most of the new work is in the East End, consisting mainly of first-class residences and several good churches. Architect W. A. Thomas is preparing plans for a fifteen-room buff brick colonial residence on Fifth and Shady Avenues, also a twelve-room brick dwelling on Rebecca Street, for Mrs. R. Davis.

Architect E. B. Milligan is preparing plans for two brick dwellings in the East End for Reed B. Coyle, Esq., one a fifteen and the other an eleven-room building; also two brick dwellings for Dr. Connell, at Oakland.

Architect E. M. Butz is preparing plans for a $20,000 colonial dwelling on Wightman Street, for Colonel Robinson.

Architect T. D. Evans has prepared plans for four brick dwellings, to be erected on Elgin near Highland Avenue, for Jno. Fite, Esq.

Architects Alden & Harlow have closed the contract for the erection of a two-story brick resi-

TERRA-COTTA DETAIL, OFFICE BUILDING, WALL STREET, NEW YORK CITY.
Jardine, Kent & Jardine, Architects.
Executed by the New Jersey Terra-Cotta Company.

dence for J. C. Jennings, Esq., Fifth Avenue and Lilac Street, to cost $20,000.

Architects Struthers & Hannah are preparing plans for a brick military drill hall for Grove City College.

Architects Rutan & Russell have prepared plans for a warehouse for the Hayes estate, to be erected on Liberty Street.

Architect Charles Bickel is preparing plans for a five-story apartment building.

Architect L. H. Raisig is preparing plans for a row of store and apartment buildings, to be erected at Homestead, for Dr. McCaslin, of that place.

IMPOST CAP, ENTRANCE BOHEMIAN CLUB, NEW YORK CITY.
Julius Franke, Architect.
Executed by the Excelsior Terra-Cotta Company.

A NEW SIDEWALK LIGHT.

A DESIGN for a new sidewalk vault light has been gotten out by the American Mason Safety Tread Company, whose non-slipping specialty has now become so well known among architects. The new light, of which a cut is given in the advertising columns of THE BRICKBUILDER, page xxxvi, this month, seems to be, in many of its features, an advance over any now in use. In the first place, its surface is protected by strips of lead under the Mason patent against the possibility of becoming slippery, a very distinct improvement, when the cost and annoyance of the iron pegs usually used is considered, and that in a busy place they wear so rapidly that they require to be renewed frequently. The lead strips are sufficiently near together to furnish absolute security against slipping, and experience has shown that even rain or light snow does not neutralize this advantage. The largest lighting area consistent with strength is given, and to secure the glasses against breakage by the action of frost, they are set with a special lead cement. It is the purpose of the company to furnish the best and safest light possible to be made, and the enterprise will surely enlist the interest of architects, who have long been conscious of the imperfections of the light now used. The company will send a full-size blue print on application.

WITH THE BUSY.

T. W. CARMICHAEL claims to have invented a clay screen which has two or three times the capacity of any screen on the market.

O. W. PETERSON & Co., Boston, Mass., are furnishing the brick on the Robinson Street School, Dorchester, Mass., A. Warren Gould, architect; also on the Registry of Deeds Building, Cambridge, Mass., Olin W. Cutter, architect.

CHAMBERS BROTHERS COMPANY, Philadelphia, report a very gratifying interest in their exhibit of brick-making machinery on the part of visitors to the Tennessee Centennial, at Nashville, and state that they have already pocketed some orders as an indirect result of this exhibit.

T. W. CARMICHAEL, Wellsburg, W. Va., has shipped the fourteenth clay steamer for this season. The last shipment was to Christiania, Norway, in response to an order by cablegram.

RUFUS E. EGGLESTON, Philadelphia, has just closed a contract for the furnishing of the Gale Automatic Sash Locks and the Bolles Revolving Windows in the new building for the Bell Telephone Company of that city, 11th and Filbert Streets; Charles McCaul, builder.

CELADON ROOFING TILES, Charles T. Harris, lessee, have been specified for the following: —

Residence for T. B. Crary, Binghamton, N. Y. Residence for G. W. Griswold, Hornellsville, N. Y. Home for the I. O. O. F., Springfield, O., Yost & Packard, architects.

BEST BROTHERS' Keene's cement (for which Fiske, Homes & Co., Boston, are exclusive agents) has been specified for over fifty apartment houses, business blocks, and residences now being erected, and about one hundred having been plastered either wholly or partially with it during the past eighteen months.

THE new Houghton & Dutton building on Tremont Street and Pemberton Square, Boston, is being supplied with white mottled brick, manufactured at Fiske, Homes & Co.'s factory, South Boston. The architectural terra-cotta and the fire-proofing, and the lime and cement are also being furnished by them.

CONTRACTS have been closed for placing the Bolles Sliding and Revolving Sash in Dr. Kelly's Hospital, and an office building, corner Lexington and Davis Streets, Baltimore, also in a large residence in Hagerstown. The warehouse of George Blome & Son will be fully equipped with these improved sashes within the next month.

TERRA-COTTA DETAIL, BANK BUILDING, DOYLESTOWN, PA.
Baker & Dallett, Architects.
Executed by the Conkling, Armstrong Terra-Cotta Company.

THE ZANESVILLE MOSAIC TILE COMPANY, of Zanesville, Ohio, are furnishing, through their Boston agents, O. W. Peterson & Co., the tiles for the apartment house of A. Bilafsky, on Beacon Street. The tiles will be used in twenty-four bathrooms, seventy-two fire-places, and in the main halls and vestibules.

THE PERTH AMBOY TERRA-COTTA COMPANY have recently closed the following contracts for architectural terra-cotta: —

Church and Clergy House, 88th Street, between First and Second Avenues, New York, N. Y., Messrs. Barney & Chapman, of New York City, architects. New York Telephone Building, 30, 32, and 34 Gold Street, New York, N. Y., Mr. Cyrus L. W. Eidlitz, of New York City, architect. Addition to Crotona Park Public Build-

ing, Crotona Park, N. Y., Mr. George B. Post, of New York City, architect.

The New Jersey Terra-Cotta Company, of New York, have secured through G. R. Twichell & Co., Boston, their New England agents, the contract to supply the terra-cotta on the Brewer Building, Worcester, Mass. George H. Clemence, architect, Worcester. Norcross & Cleveland, contractors, Boston. Terra-cotta to be of a salmon shade.

The Cummings Cement Company, with works of enormous capacity at Akron, N. Y., are running one quarter overtime, in an endeavor to keep pace with the rapidly increasing demand for its rock and Portland cements, the larger share of which is being used for street paving in Buffalo and other large cities in New York and Pennsylvania.

The Hydraulic Press Brick Company, St. Louis, have just secured a contract for over three hundred thousand enameled bricks for the interior of the Burlington depot at Omaha, Neb. They are also putting on the market a white face brick with a surface that is impervious, and when soiled can be cleaned with soap and water. The surface is not glazed.

The Excelsior Terra-Cotta Company, through their Boston representative, Charles Beacon, have closed the following contracts for architectural terra-cotta: Converse Building, Boston; Winslow & Wetherell, architects; L. P. Soule & Son, builders. Cambridge Savings Bank, Cambridge, Mass; C. H. Blackall, architect; Norcross & Cleveland, builders.

Messrs. Frank Sears, of New York, and Charles B. Sears, of Chicago, formerly managers of the business of the late James Brand, in association with Mr. Wm. S. Humbert, of Buffalo, N. Y., will continue in that long-established business, under the style of Sears, Humbert & Co., with offices in New York City, Buffalo, and Chicago. The new firm will continue the importation of the La Farge, Josson, and Burham Portland cements, and will, besides, represent the American Cement Company in the West.

The Powhatan Clay Manufacturing Company's bricks are now being used in the store and loft building at 39th Street and Fifth Avenue, business building at Forsyth and Hester Streets, flats at 143d Street and Seventh Avenue, interior of laundry of St. Joseph's Orphan Asylum, 401 E. 89th Street, all of New York City.

They have recently closed the contracts for the kindergarten at Rivington and Cannon Streets, flats on 117th Street, near Lenox Avenue, and the business building at 590 Broadway, New York City.

In all of the above the brick is their cream white.

The Eastern Hydraulic Press-Brick Company have recently furnished their iron-spot bricks for lining the interior of one of the handsomest churches in Rochester, N. Y.,— St. Paul's Episcopal. They are also just completing a contract for furnishing their gold-colored bricks for lining the interior of the St. Stephen's Episcopal Church, at Wilkesbarre, Penn. Those who have seen the effect pronounce it beautiful, and, as it is somewhat of a departure, it will be of interest to our readers, and should lead to an increased use of light-colored bricks for the interior of churches and other large public buildings.

Conkling, Armstrong Terra-Cotta Company, through their New England agent, Charles E. Willard, have secured the contract to supply the terra-cotta for Times Building, Hartford, Conn., George B. Rogers, architect; the St. Anne Church, Somerville, Mass., Keeley & Houghton, architects, Brooklyn, N. Y., S. Brennan & Co., contractors; the A. D. Puffer Building, 1651 Washington Street, Boston, A. H. Nelson, architect; the Paul Revere School, Boston, Peabody & Stearns, architects; the Revere Town Hall, Greenleaf & Cobb, architects; and the new building for the Puritan Brewing Company, Charlestown, Mass., Hettinger & Hartmann, architects.

Chicago Terra-Cotta Roofing and Siding Tile Company report the following buildings completed last month, on which their goods were used for roofing: —

Residence, Buffalo, N. Y., Swan & Faulkner, architects, French tile. Residence, Titusville, Pa., C. W. Terry, architect, Oil City, Pa., small Spanish. Residence, Calumet Avenue, Chicago, S. B. Eisendrath, architect, French tile. Apartment Building, Wright Street, Chicago, Anderson & Gelin, architects, French tile. Residence, Douglas Boulevard, Chicago, Burtar & Gassman, architects, small Spanish. Memorial Church, Wheeling, W. Va., Franzheim, Giesey & Faris, architects, Spanish. Residence, Key West, Fla., large Spanish tile. Residence, St. Louis, A. M. Baker, architect.

Mr. Ross F. Tucker, the Manager of the Manhattan Concrete Company, has been awarded the contract for completing the several splendid buildings at the University of Virginia, of which Messrs. McKim, Mead & White are the architects. The Manhattan Concrete Company has a large contract for elaborate ornamental concrete on these buildings. The Manhattan Concrete Company has just finished a large contract on the Mills Houses, Bleeker, Sullivan, and Thompson Streets, New York, Ernest Flagg, architect. The work covered under this contract consisted of all floors and roof, 149,000 sq. ft. These floors were built for the most part in cold weather last winter, without the loss of a single foot. All floors throughout were finished with "Granitoid" similar to that being put down by this company on Boston Common, but of finer texture. The basement areas are lighted by the Manhattan Vault Light, a very superior and excellent construction. The building as a whole is a fine example of what can be done with concrete when properly used.

Sayre & Fisher Company, through their Boston representative, Charles Bacon, have closed the following contracts for supplying bricks.

Revere Beach Bathing Establishment, Revere, Mass.; pink brick and enamel; Stickney & Austin, architects, W. T. Eaton, contractor.

Real Estate & Trust Company Building, Atlantic Ave., Boston, mottled brick (gray); Peabody & Stearns, architects, C. E. Clark & Whitney, contractors.

West End Power House, Cambridge, Mass., white enameled brick; W. E. Whidden & Co., contractors.

Converse Building, Milk Street, pink brick; Winslow & Wetherell, architects, L. P. Soule & Son, contractors.

Cambridge Savings Bank, Cambridge, gray brick; C. H. Blackall, architect, Norcross & Cleveland, contractors.

Apartment house, Brookline, mottled brick; C. E. Dark, architect, E. F. Staples, contractor.

White Building, Boylston Street, white enameled; Winslow & Wetherell, architects, L. P. Soule & Son, contractors.

Massachusetts Historical Society, Fenway, Boston; Wheelright & Haven, architects, L. D. Wolcutt & Son, contractors.

Messrs. Fiske, Homes & Co., Boston, report a satisfactory business in their brick specialties. The following schoolhouse buildings are being supplied: —

Springfield, Mass., high school, Hartwell, Richardson & Driver, architects. Melrose, Mass., high school, Tristram Griffin, architect. Cambridge, Mass., normal school, Hartwell, Richardson & Driver, architects. Marlboro, Mass., high school, C. E. Barnes & Co., archi-

tects. Hartford, Conn., grammar school, C. W. Brocklesby, architect. Gardner, Mass., grammar school, Barker & Nourse, architects. North Adams, Mass., grammar school. Newton, Mass., high school, Hartwell, Richardson & Driver, architects. All taking approximately 1,500,000 bricks.

Among the smaller orders booked are: —

Block of apartment houses, Blackwood Street, Boston; 40,000 bricks. Large apartment houses, Mountford Street, Boston; 75,000 bricks. Large apartment houses, Copeland and Warren Streets, Roxbury; 75,000 bricks. Apartment house, Forest Street and Mt. Pleasant Avenue, Roxbury; 25,000 bricks. Apartment house, Ruggles Street, Roxbury; 75,000 bricks. Block of apartment houses, Batavia Street, Boston; 60,000 bricks. Block of apartment houses, St. Germain Street, Boston; 55,000 bricks. Two business blocks, Haverhill, Mass., 25,000.

THE Cleveland, O., *Leader*, says: —

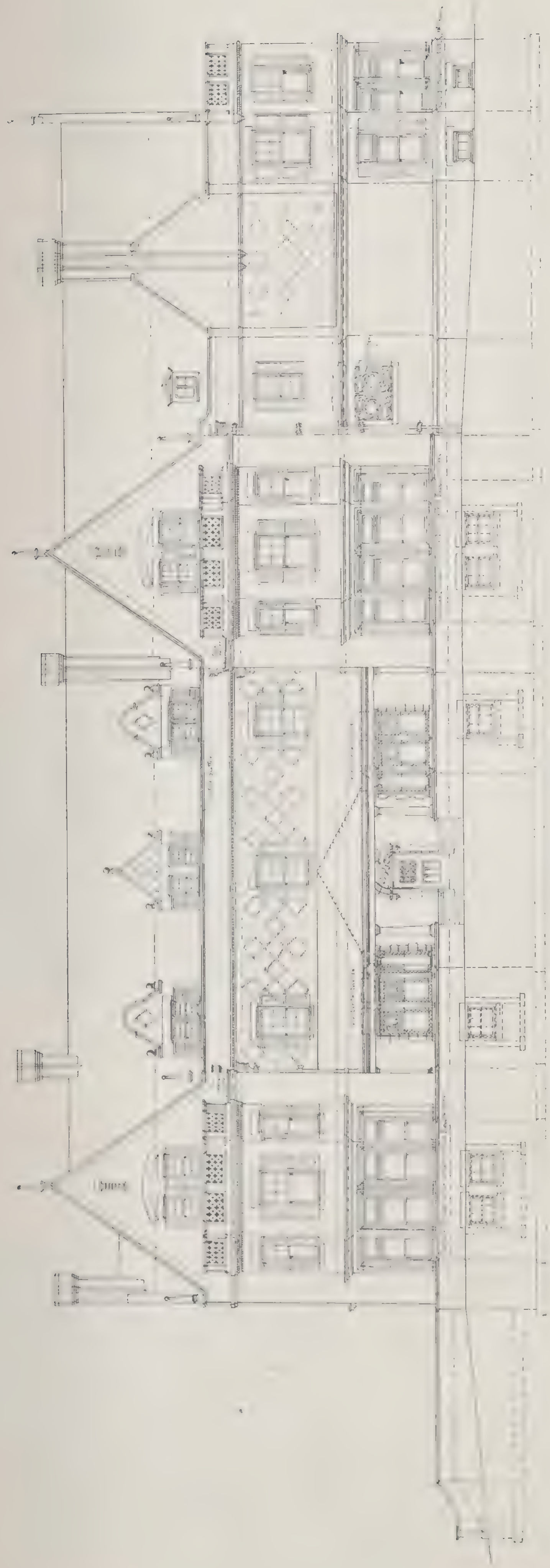
"Vitrified shale clay glazed is being successfully used as cattle guards on the Cleveland, Canton & Southern Railroad. The new material being stable, durable, and inexpensive will likely be adopted universally, not immediately, but gradually. Railroad officials have found cattle guards made of wood or metal unsatisfactory, it is said, for several reasons. It has been found necessary to replace the old-fashioned protectors frequently, and careful watching is required to keep them in repair and in position.

"About a year ago the Cleveland, Canton & Southern Company experimented with the vitrified shale clay guards, and the success that has attended their use has induced the management to adopt them on all parts of the line. Railroad officers state that the new invention promises to supersede the systems now in use, many advantages being claimed for the glazed vitrified shale clay. It is said to be less expensive than wood, and to cost about a fifth what iron guards cost, a feature which is advantageous in these days of economical railroading. The guard is composed of short sections fastened together with iron rods if desirable, but this is not considered necessary. Being glazed they do not need painting, and rains and winds keep them clean. The manufacturers of the guards have decided not to build a factory, but to send dies to a brickyard near where the order goes, thus saving transportation charges. It is claimed that almost any brickyard can make them when furnished the dies. The manufacturers are Cleveland and Canton men."

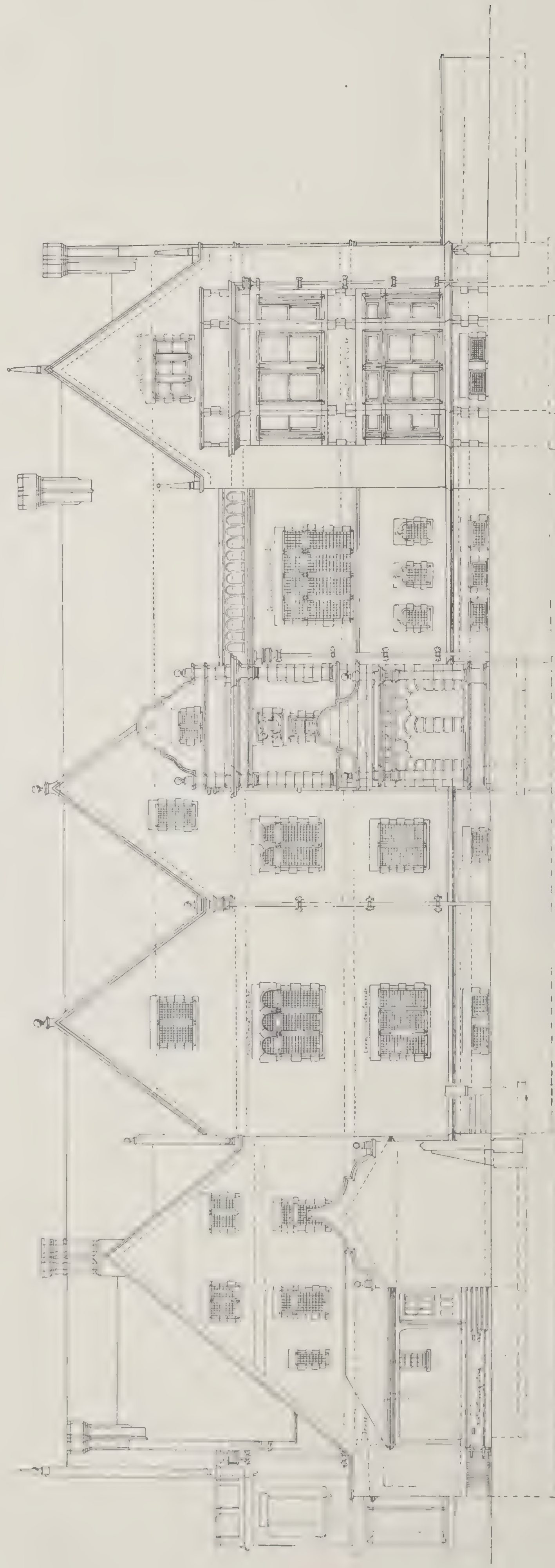
These guards are made on the machines of The American Clay-Working Machinery Company, of Bucyrus.

TREASURY DEPARTMENT, Office Supervising Architect, Washington, D. C., July 8, 1897. SEALED PROPOSALS will be received at this office until 2 o'clock P. M. on the tenth day of August, 1897, and opened immediately thereafter, for all the labor and materials required for the erection and completion (except heating apparatus, vault doors, and tower clock), of the United States Post-Office, etc., building at Paterson, N. J., in accordance with the drawings and specification, copies of which may be had at this office or the office of the superintendent, at Paterson, N. J. Each bid must be accompanied by a certified check for a sum not less than two per cent. of the amount of the proposal. The right is reserved to reject any or all bids, and to waive any defect or informality in any bid, should it be deemed in the interest of the Government to do so. All proposals received after the time stated for opening will be returned to the bidders. CHAS. E. KEMPER, Acting Supervising Architect.

VOL. 6. NO. 8. PLATE 65.



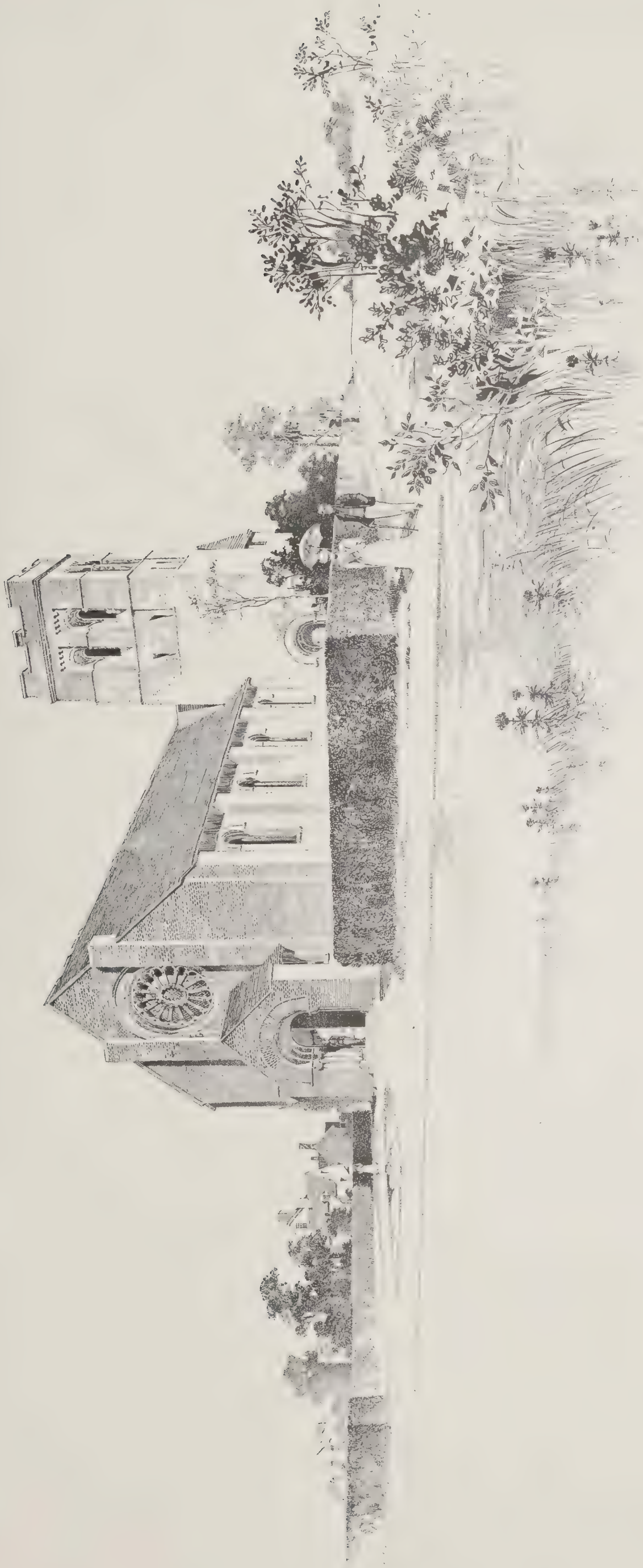
West Elevation.



East Elevation.

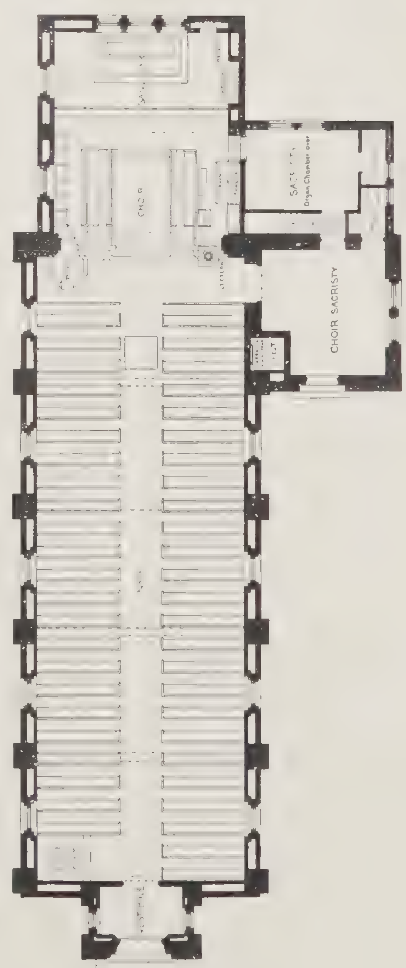
RESIDENCE AT MADISON, N. J.

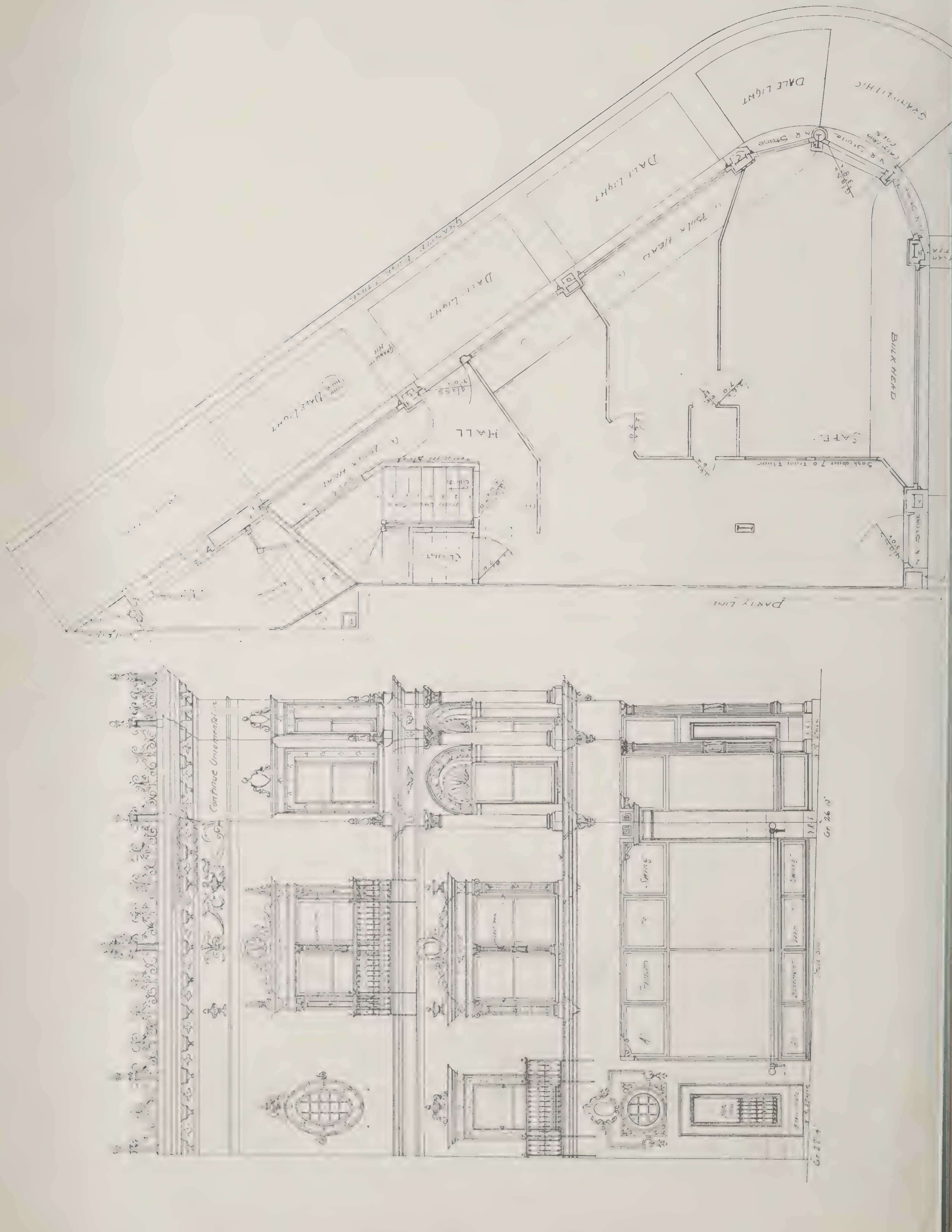
CLINTON & RUSSELL. Architects.

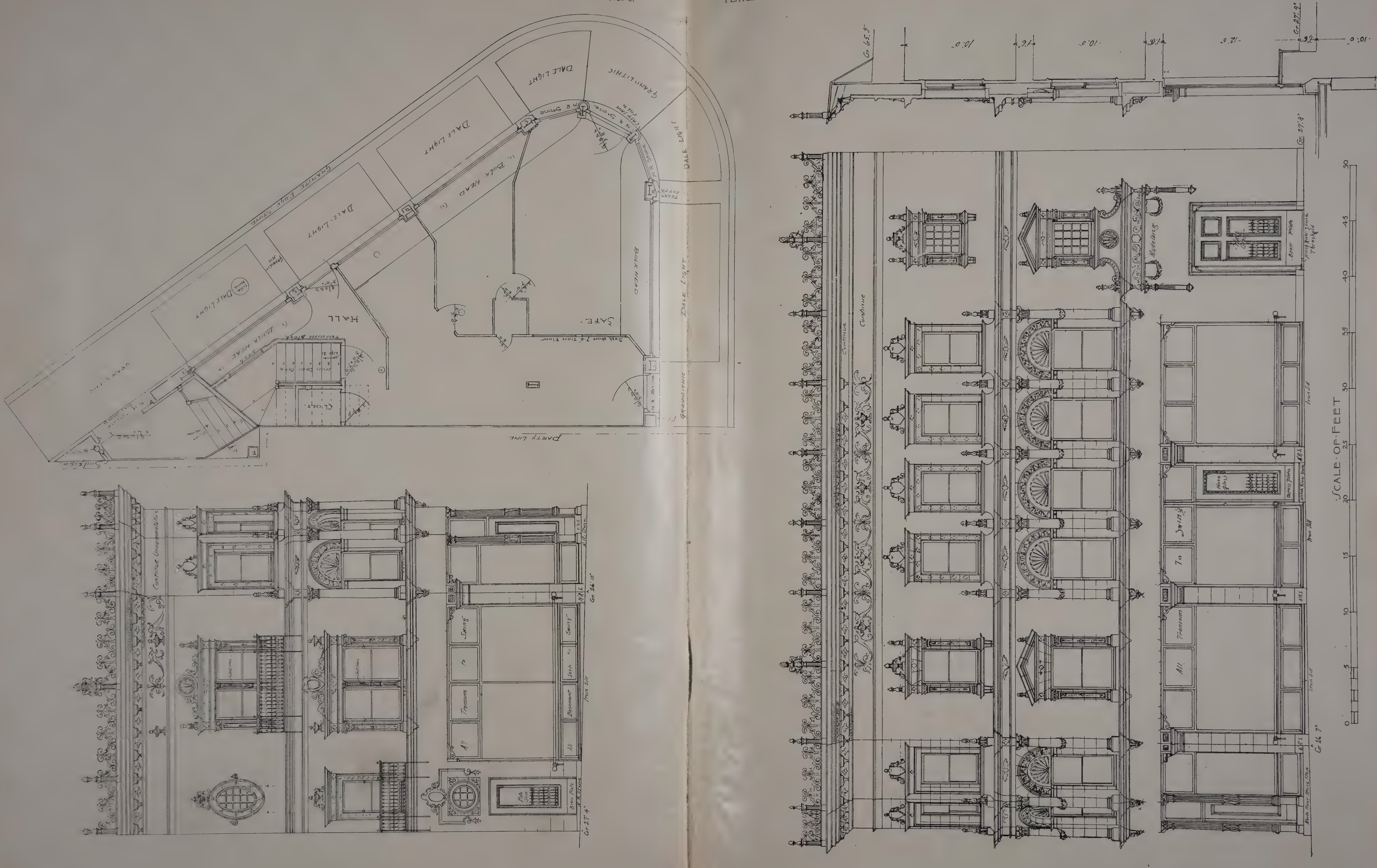


ST. ANDREW'S BY THE SEA EPISCOPAL CHURCH, EDGARTOWN, MASS.

CRAM, WENTWORTH & GOODHUE, ARCHITECTS.

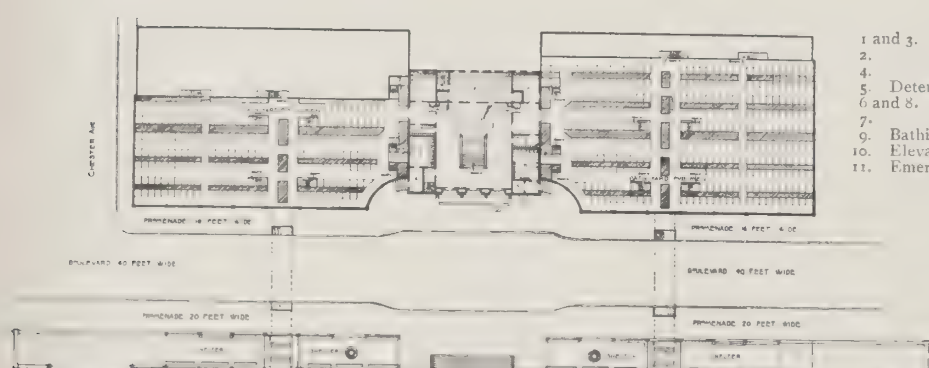



DALE LIGHT
DALE LIGHT
DALE LIGHT
BULK HEAD
BULK HEAD
HALL
SAFE
PARTY Line
Continue Ornamentation



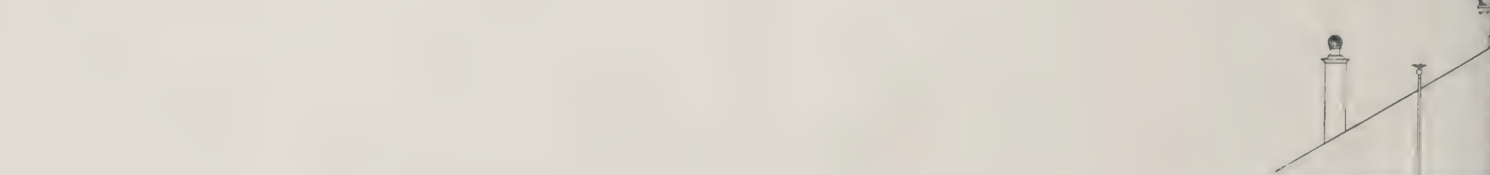
OFFICE BUILDING FOR THE PROCTOR ESTATE, BOSTON, MASS.

WINSLOW & WETHERELL, ARCHITECTS.



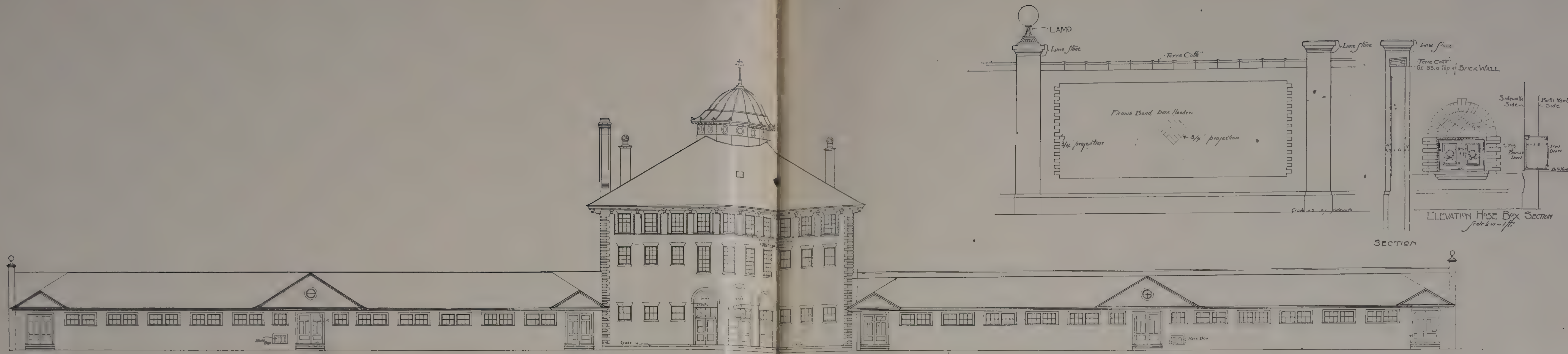
1 and 3. Women's Toilet Room.
2. ,, Valuables.
4. ,, Ante Room.
5. Detention Room.
6 and 8. Men's Toilet Room.
7. ,, Valuables.
9. Bathing Suit Room.
10. Elevators.
11. Emergency Doors.

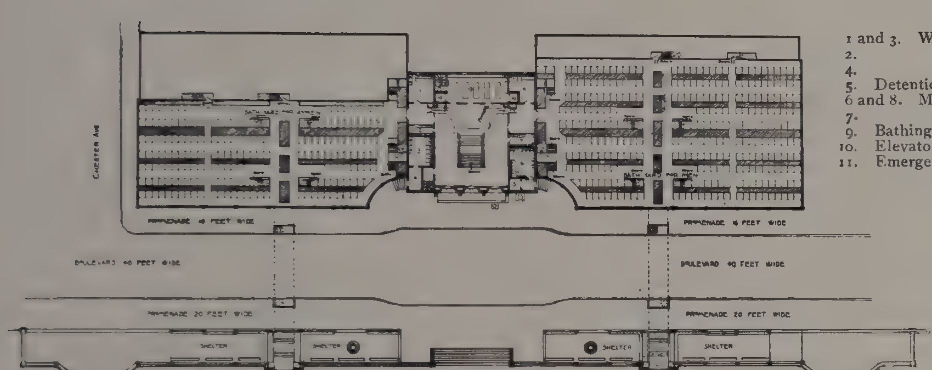
FIRST FLOOR PLAN.



BATHING ESTABLISHMENT, SHEL

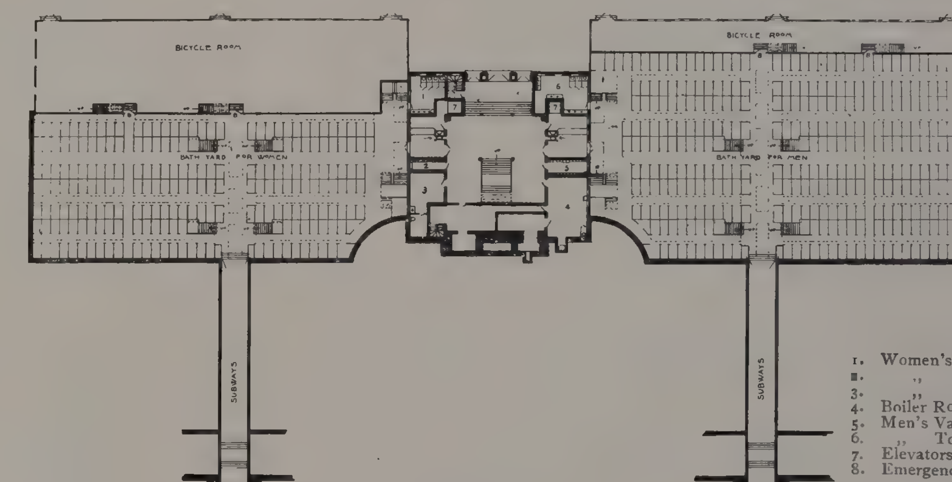
STICKNE





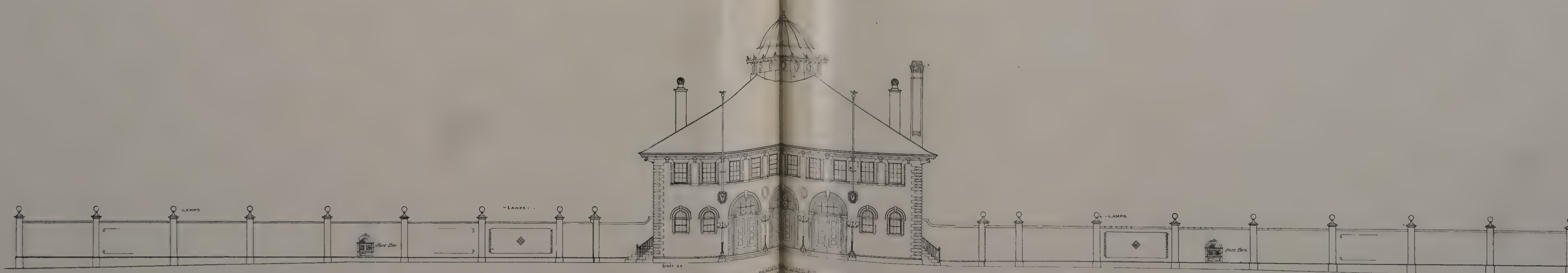
1 and 3. Women's Toilet Room.
2. ,, Valuables.
4. ,, Ante Room.
5. Detention Room.
6 and 8. Men's Toilet Room.
7. ,, Valuables.
9. Bathing Suit Room.
10. Elevators.
11. Emergency Doors.

FIRST FLOOR PLAN.



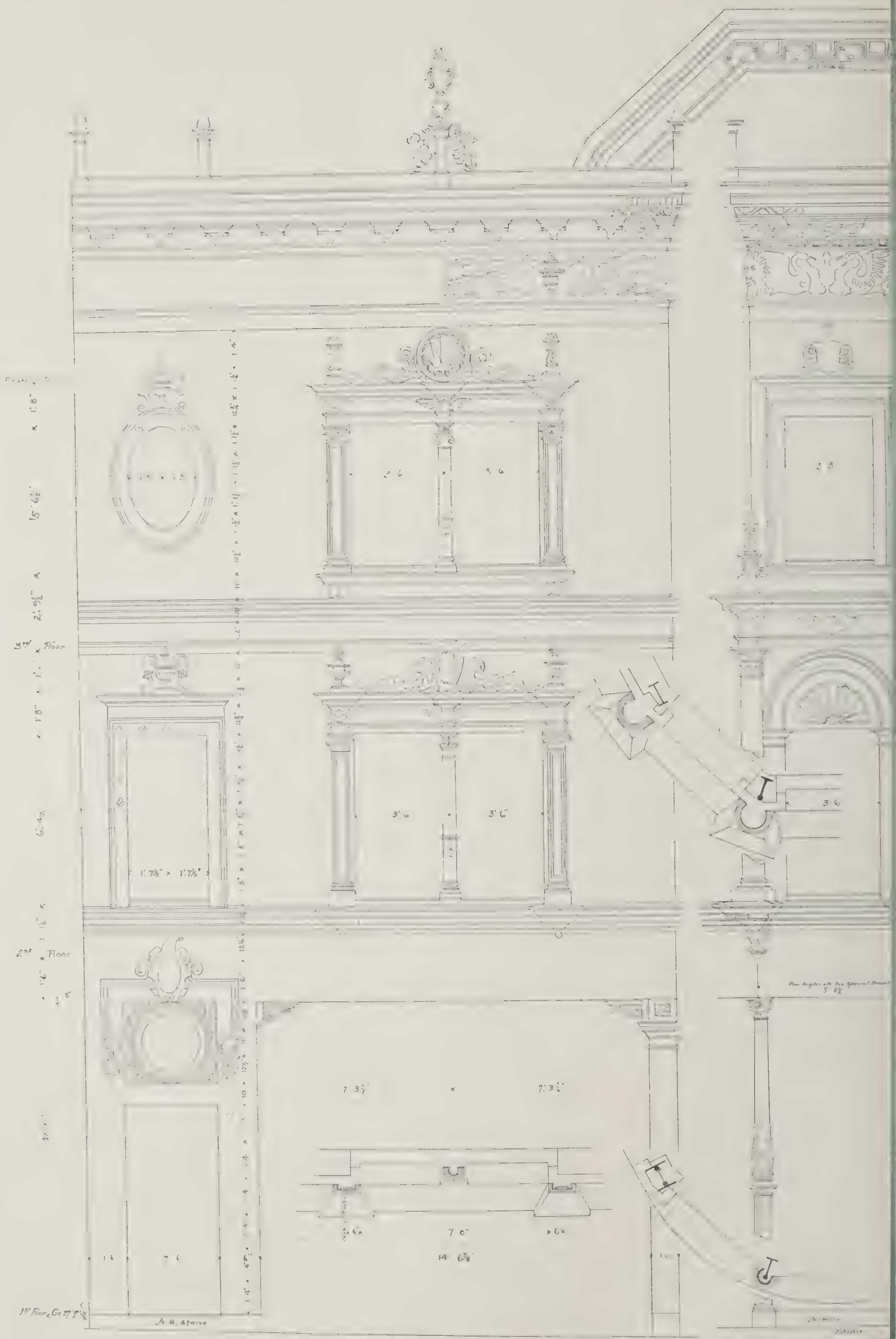
1. Women's Toilet Room.
2. ,, Valuables.
3. ,, Retiring Room.
4. Boiler Room.
5. Men's Valuables.
6. ,, Toilet Room.
7. Elevators.
8. Emergency Doors.

BASEMENT PLAN.

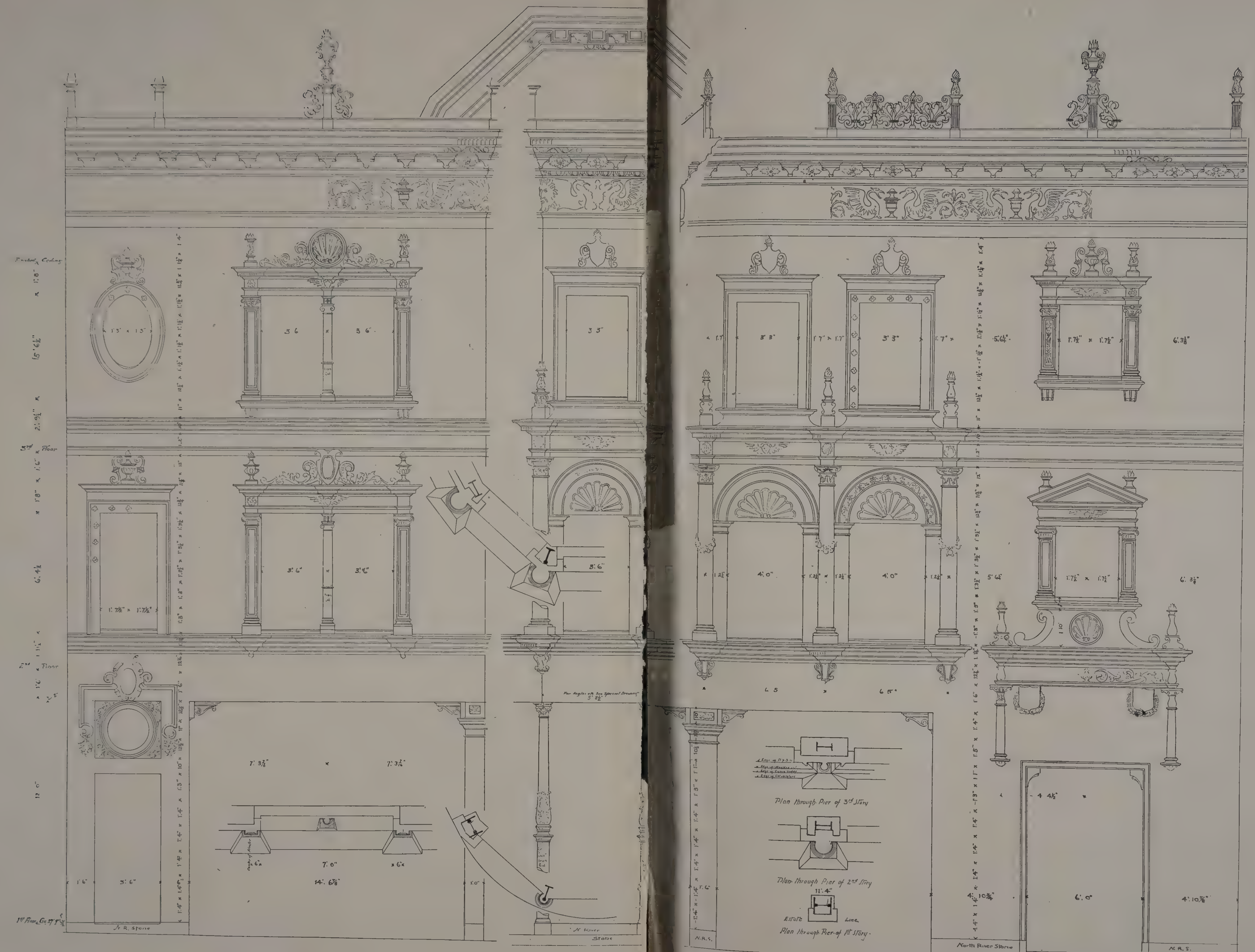


BATHING ESTABLISHMENT, SHELTERS AND SUBWAY, REVERE BEACH, MASS.

STICKNEY & AUSTIN, ARCHITECTS.



DETAILS, OFFICE BUILDING FOR
WINSLOW & W



DETAILS, OFFICE BUILDING FOR TH[E P]ROCTOR ESTATE, BOSTON, MASS
WINSLOW & WET[HER]ELL, ARCHITECTS.

·THE·
BRICKBVILDER

VOLVME VI
SEPT. 1897
No. 9

OFFICE 85 WATER STREET BOSTON

THE BRICKBUILDER.

AN ILLUSTRATED MONTHLY DEVOTED TO THE ADVANCEMENT OF ARCHITECTURE IN MATERIALS OF CLAY.

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THE REASONABLE PRINCIPLES OF ARCHITECTURAL COMPETITION.

THERE are four issues of primary importance which must be considered in defining a good architectural competition. The first point is the legal validity of the contract between the competing architects and the owner. Second, the financial considerations of this contract. Third, the considerations other than those purely financial. Fourth, the clear subordination of either the cost to the accommodation, or the accommodation to the cost.

FIRST: THE COMPETITION AGREEMENT SHOULD BE A DOCUMENT VALID IN THE COURTS.

We recognize two distinct kinds of architectural competition: limited competitions, in which the owner invites a limited number of architects to compete; and open competitions, in which all architects are free to enter at their own option.

These two sorts of competition may be variously combined or modified; but whatever form a competition may take, the relation existing between competitors and owner is first, last, and always a *business* relation. Its purpose is an exchange of goods or services to the profit of both parties. It is not profitable to an owner if a competition results in furnishing him with a lot of plans of no real service to him, nor is it profitable to architects to run this part of their business at an average loss. *Only those forms of competition are profitable which rest upon a sound business basis, and which bring an equal benefit to both sides.* This being granted, it follows that these benefits should be legally assured to both parties to the contract.

Important competition agreements should be tentatively drawn and submitted to the inspection of legal council on both sides; and especially should architects refrain from accepting such agreements until the documents have received such scrutiny. This reform must be effected through the machinery of their professional organizations.

The competition agreement or contract cannot be valid unless, first, the parties issuing it are empowered by law to fulfil it in all respects; and second, unless it be so drawn as to leave no legal uncertainty as to its meaning. The more terse the document the better. The word "shall" should be regarded with the highest suspicion.

SECOND: THE FINANCIAL CONSIDERATIONS OF THE COMPETITION AGREEMENT.

If an architect conducts his office with reasonable economy, he should make as net profit about one half his gross receipts. The usual payment for services being 5 per cent. of the total cost of the building, any one piece of work would bring him on an average a profit of 2½ per cent. of its cost. When, therefore, the award of the commission to design and erect a certain building is the declared aim of a competition, this 2½ per cent. of its cost is the money prize for which architects compete.

Now, before architects can fix a price for their services for entering into competition, they must know whether this prize is assured to one of the competitors, or not. What is necessary is a definite statement which can be legally maintained one way or the other. In most cases where competitions are held the erection of a building has been definitely decided upon, and it is a very remote contingency that may prevent its erection. The only appreciable danger, therefore, in announcing the commission for the building as the prize of the competition is that no one of the competitors will prove a suitable person to design and erect it. This danger is absolutely avoided by having a limited competition to which only capable architects are invited; but, inasmuch as even with excellent competitors there is a remote possibility that something may cause the abandonment, or essential modification of the owner's intention, a mode of liquidating his indebtedness to the winning architect should be provided in the competition contract, and this, of course, would be the payment to the winning architect of 2½ per cent. on the proposed cost of the building, the money equivalent of the commission.

If, then, a competition agreement guarantees the prize of the competition to be the award of the building or the payment of 2½ per cent. of its proposed cost, the architect has a definite business proposition upon which to base the price of his services. Whether this price be low or high will next depend largely upon the following considerations.

An architect's chance of winning a competition depends, first of all, upon his ability, and second, upon the number of contestants in the competition. Exceptional ability always has its premiums, and is exempt from ordinary rules; but the great majority which constitutes the average man must recognize their force and conform to them. They must obey the law of averages, or violate them at their own risk.

Now, suppose a competition to which five men are invited. By the law of averages each man has but one chance in five of winning that competition, and in a round of five such competitions he stands

to lose four times and win once. As we found above, the net profit of a $300,000 building is 2½ per cent. on its cost, or, $7,500. This is clear gain. In competitions of five contestants for such a building each architect therefore stands to win $7,500, minus the loss to him of preparing four different sets of unused sketches. The normal value of each of these sets of sketches is 1 per cent., or $3,000, according to the schedule of the American Institute of Architects. Half of this amount is reckoned as the cost of the drawings, half as profit. *Profit, however, is only another name for the payment made to the architect for his own individual services.* The profit for a year represents what he personally earns in a year, just as the laborer's income is the sum of his total wages. If the laborer did his day's work and was denied payment for it, his case would be the same as that of the architect who made competition sketches and was paid only the "cost" of them. The architect loses as clearly in that case as the laborer when his day's wages are withheld.

Accordingly, if an architect, acting upon the suggestion of certain leading members of his profession in New York, decides that otherwise proper competitions may be accepted when payment of cost alone is made for sketches, he is then doing that work at the loss of his own individual wages, which, in the instance taken, amount to $1,500. His total losses in a round of five competitions would be four times $1,500, or $6,000. His total winning, the profit of the full commission for the building, would be $7,500. This, therefore, leaves him a saving of $1,500, *or one half of 1 per cent. on the cost of the building, as his entire profit on work which normally brings a profit of 4½ per cent.;* namely, four different sets of competition sketches at 1 per cent. each and one full commission at 5 per cent. This, clearly, is a very narrow margin of profit, yet it is sufficient to permit us technically to define a competition on this basis as profitable.

When, however, the number of contestants varies from that taken in the previous example, different results are found. In competitions of ten contestants the architect stands to lose nine times and win once. Computing as above, his losses in ten such competitions would be nine times $1,500, or $13,500, while his one winning brings him in but $7,500, making a total loss of $6,000 if he should enter ten such competitions.

Equally, when the move is in the other direction and the number of contestants is lessened, the architect stands to increase his margin of profit. In competitions of only two, where each contestant should win one effort in two, the loss would be only $1,500, to a gain of $7,500, leaving a profit of $6,000 on a round of two competitions.

The following is a summary of what each architect stands to win or lose in competitions comprising up to ten competitors for a $300,000 building, when the commission, or an equivalent payment, is guaranteed, and each competitor is paid one half of 1 per cent. as the cost of his competition sketches.

No. of competitors.	Each receives in one round of competitions.		Each loses in one round of competitions.		Difference between receipts and losses.		Number of competitions in one round.		Each stands to win or lose in each competition.
2	$7,500	minus	$1,500	equals	$6,000	divided by	2	equals	$3,000
3	7,500	"	3,000	"	4,500	"	3	"	1,500
4	7,500	"	4,500	"	3,000	"	4	"	750
5	7,500	"	6,000	"	1,500	"	5	"	300
6	7,500	"	7,500	"	0	"	6	"	0
7	7,500	"	9,000	"	—1,500	"	7	"	—214
8	7,500	"	10,500	"	—3,000	"	8	"	—375
9	7,500	"	12,000	"	—4,500	"	9	"	—500
10	7,500	"	13,500	"	—6,000	"	10	"	—600

The deductions from this investigation are of the greatest importance, and may be worked out by the owner and the architect as their interests impel them. Certainly it is very clear why it is the owner's interest to keep the number of contestants as small as possible, and to select only architects of the highest ability.

We are also prepared to understand why open competitions are not deemed profitable by architects; for if, as in the above example, a single limited competition of ten contestants with the award of the building guaranteed, and each competitor paid the cost of drawings, means an average loss of $600 to each of those who enter it, it is not reasonable to suppose that architects of standing and intelligence will enter competitions where the individual recompense is not assured at all, and where the number of contestants is entirely unlimited.

THIRD: CONSIDERATIONS OF THE COMPETITION AGREEMENT WHICH ARE OTHER THAN FINANCIAL.

All the advantage that an architect receives in entering into competition is not financial. Otherwise there would be no such discounting of the price of services as is now usual. His greatest inducement, after the financial one, is the ambition of every architect to erect important buildings. It makes a great difference, therefore, to an architect already in good practise, whether the erection of the building is assured or not. The chances of losing the building through the selection of one of the other competitors, when multiplied by the chances of the owner's withdrawing the building altogether, forms too great a hazard for him to consider in cases where the erection of the building is not guaranteed. Guaranteeing the erection of the building, therefore, presents an inducement over and above the merely monetary security it gives, and constitutes a consideration which owners cannot fail to regard.

Another consideration of the greatest importance is the assurance of just dealing between competitors. The knowledge of the owner's integrity and right of intention does not of itself offer this assurance. It is not the lack of right intentions that wrecks competitions, but the blunders of men unaccustomed to the task of directing them. Architectural competition is not at its best unless it is so conducted as to give free play to the contestants' spirit of emulation. In this respect it is like all sports which aim at the highest attainment of the individual. Such forms of emulative competition must be conducted under rules very different in nature from those which govern in the courts of law. The rules which govern the sports may often seem absurdly technical to the non-sportsman, yet they are evolved by long practise, and are essential to the moral health of the sports conducted under them, quite as much as the laws of our courts are essential to the social safety of the community; but the difference between them is a very essential one. The law of the courts obliges a plaintiff to prove his injury, as well as the facts alleged. The law of sports makes the fact and the injury identical. It is not necessary for a yacht to prove that she has been injured in a collision brought about through the fault of another boat to claim a foul and its penalty, nor need she show a loss if forced off her course improperly. The penalty attaches to the fact of interference, and the question of the amount of injury caused by that interference, or of intention, which forms so large an issue in the courts of law, is not considered. A blunder is a crime, and is punished as such.

Additional instances might be set forth at length, showing conclusively that in all those fields of competition where the highest perfection of individual attainment is sought, the law sanctioned by experience absolutely safeguards the interests of those who maintain the rules set down, and as absolutely condemns those who break them. The rules themselves thereby come to have an importance appreciated only by those who have watched their long application, and have learned their necessity. It matters not so much what the rules may be as that their integrity be maintained. Otherwise there is no assured freedom for any, and the best conditions to enthusiastic effort are lacking.

The rules which govern competitions should therefore be as few and as distinctly stated as possible, and the restraints imposed of a kind which leave free the best faculties of the competitor. The penalty for an infringement of these rules must be the instant, final, and unequivocal disbarment of the transgressor. These rules can only be drawn up by one who has devoted time and thought to the science of conducting architectural competitions.

Still another consideration valued by architects is the knowledge that their plans are to receive the judgment of one able to appreciate their finer shades of excellence, and a reasonable assurance that the opinion of such a judge will be an important factor in determining the award.

FOURTH: RELATIVE DEMANDS REGARDING COST AND ACCOMMODATIONS.

There is yet another most important consideration, which appears to have hitherto been very largely overlooked. We refer to the habit of stating in competition programs in an absolute way both the accommodations of the building, and its limit of cost. This arbitrary method defeats its own end. The architect is not omniscient, and cannot possibly arrive at any right estimate of what it will cost to meet the given conditions until his sketches are made, and the time for sending them in is close at hand. The competition cannot then be declared closed upon his representations and new instructions issued. It is too late. The drawings go in and disaster follows. All drawings are declared rejected because none fall within the limit of cost. Whose fault is it? It is hard to say.

Surely no architect should be so silly and no committee so fatuous as to believe that absolute statements of cost and absolute statements of accommodation, size, materials, etc., can be unchangeably determined before plans are made, *for it is precisely to determine the relation of these two things that the architect makes his drawings.*

If the cost must be absolutely limited, it will pay the owner to let the architects exercise their intelligence in adjusting his desires to his pocketbook; but if, as in most buildings, the accommodations demanded are in reality the essential thing, it is certainly enough to state with emphasis that economy in meeting these demands will form an important issue in determining the award.

ROBERT D. ANDREWS.

THE recent International Congress of Architects, which was held in connection with the Brussels Exposition during the past month, has awakened considerable interest on the part of architects in this country and abroad; and although America was represented by but four delegates, if we are properly informed, out of a total attendance of about three hundred, the eminence of those participating in the deliberations of the congress and the ideas which were developed in the discussions have combined to give it a peculiar value. It is to be hoped that these international congresses may become more frequent. No country can live to itself in art any more than in anything else, and in these days when architecture is so essentially a matter of convention, tradition, and concurrent practise, no one can afford to neglect an opportunity to compare his standards with those of other countries, nor to ignore the achievements of foreign architects. The object of this congress was avowedly to bring about a better understanding of the practise of architecture in the various countries and to awaken the public to a better appreciation of architecture, and although the duration was short, only five days, the program was a very full and complete one. The language of the congress was French. Great credit is due to the Société Centrale d'Architecture for the admirable manner in which the congress was organized, the cordial reception and careful consideration for the comfort and pleasures of the members of the congress, and to Mr. Dumortier for his strong and efficient management during the entire session. The congress was informally opened on Saturday, August 29, by the King of Belgium, in person, and the succeeding days were taken up with discussion of architectural topics in the mornings, and delightful excursions to surrounding points of architectural interest in the afternoon. Aside from the business transacted, the one thing which was most worthy of note was the individual character of the distinguished delegates and the high personal esteem with which they were held. There were present not only architects, but statesmen, three members of the Institute of France, one deputy, one member of the Italian parliament, and several French representatives, besides others in political and municipal affairs from many countries. That Leopold, King of the Belgians, should have come up from Ostend specially to open the congress is sufficient proof of the high esteem in which our profession is held in foreign countries.

It is to be hoped that the next congress of architects, which is to be held in connection with the International Exhibition in Paris, in 1900, may be more fully attended by our countrymen. The architectural efforts of America are hardly appreciated at all in Europe outside of England. While our architecture has not the past to boast of, which is so valuable a factor in European art, our progress during the past two decades has been along lines of which we have every reason to be proud, and in an international congress of this description our delegates ought to be able both to give and receive. We are indebted to Mr. G. O. Totten, Jr., the official delegate from the United States Government, for a very complete and interesting account of the congress.

IN this connection it is intensely gratifying in every respect to note the spirit which has accompanied the growth of the T Square Club at Philadelphia, which from being an association of young and extremely enthusiastic draughtsmen, has developed into one of the leading architectural bodies of the country, certainly being foremost in the enthusiasm which is so essential to continued interest in architecture as a profession. The club has repeatedly put itself on record in a most emphatic way as being keenly alive to its own possibilities and the general good of the profession, and its history ought to be an example to all the other clubs and architectural societies throughout the country as showing the lines in which club work can be carried along so as to profit not only the members themselves, but to form a tangible force in the advancement of art in general and architecture in particular. The T Square Club is full of live, energetic men, including among its members the best talent of the Quaker city, and by its action of sending a properly accredited delegate to the Brussels Congress of Architects, it has shown its appreciation of the position which a society of this kind can occupy in relation to its growth. We lack in this country very strongly what the French term *esprit de corps*, and architects are so constantly accused of professional jealousy, and unfortunately there is so often good reason for the charge, that we sincerely hope that the spirit of the T Square Club may spread beyond the borders of Philadelphia. Mr. Kelsey, the delegate of the club, gave a very felicitous address in which he summed up the position of the T Square Club as being pre-eminently one whose attitude was to seek and study, and every one who has had the pleasure of reading his words will feel that in this instance the profession as a whole, as well as the T Square Club, was honored by the Philadelphia delegate.

PERSONAL AND CLUB NEWS.

MESSRS. O. A. KLUMANN and Charles I. Thomas, Wilkes-Barre, Penn., have associated themselves under the firm name of Klumann & Thomas for the practise of architecture. Catalogues and samples desired.

THE Chicago Architectural Club had its first meeting after vacation, on Monday evening, September 13.

"How to Make the Most of the Club's Privileges this Coming Season" was the subject for discussion; many of the leading members offering valuable suggestions which will no doubt materialize as the season advances.

THE second annual exhibition of the Cleveland Architectural Club will be held in the New England Building, from Nov. 15 to Nov. 27, 1897.

Works will be received until Monday, November 1.

The exhibition will include:—

Architectural sketches, perspectives, and elevations in all renderings; photographs of executed work; landscape architecture; interior architecture and decoration; interior furnishings (samples and sketches); architectural and decorative metal work (wrought iron, bronze, and brass); carving and sculpture (wood, stone, metal, or plaster); advertisers' exhibit (the latest novelties and improvements for modern buildings).

All drawings for the exhibition must be framed or mounted.

The Cleveland Club will pay all charges for the collecting, shipping, and returning of contributed works.

At the first regular meeting held by the St. Louis Architectural Club after the vacation season, a general discussion of the proposed work for the winter brought out many interesting features, and considerable interest was manifest. All committees were instructed to bring in full reports at the next meeting, including a special committee which was appointed to look into the advisability of the club publishing the revised building ordinance.

Messrs. Bailey & Enders were appointed a committee to procure a suitable case for the medal which was awarded the "T" Square Club of Philadelphia some time ago, for the best club exhibit.

ILLUSTRATED ADVERTISEMENTS.

The Excelsior Terra-Cotta Company illustrate, in their advertisement on page iv, the new Mechanics Bank Building, Brooklyn, N. Y.; George L. Morse, architect.

Fiske, Homes & Co. have illustrated on their advertising page (vii), number three of their new and especially prepared designs of brick and terra-cotta fireplace mantels.

On page viii, in the advertisement of the New Jersey Terra-cotta Company, is illustrated the new New Zealand Building, Broadway, New York City; Hoppin & Koen, architects.

A residence at Buffalo, N. Y., of which C. D. Swan was the

architect, is illustrated in the advertisement of the Harbison & Walker Company, on page xxv.

Two views of the Hall Memorial Chapel, Woodlawn, Chicago, W. A. Otis, architect, are shown in the advertisement of Charles T. Harris, Lessee, on page xxix.

The Gilbreth Seam-Face Granite Company, in their advertisement on page xxxviii, show a fireplace at Lenox, Mass., of which George T. Tilden was the architect.

PLATE ILLUSTRATIONS.

Plates 73 and 74. Details of the upper stories of the Dun Building, now in course of erection on Broadway, corner of Reade Street, New York City; George Edward Harding & Gooch, architects.

The Broadway and Reade Street façades of this building are constructed of light brick and terra-cotta.

Plates 75 and 76. Details of the upper stories of the New Queen Insurance Company Building, Broadway, New York City; George Edward Harding & Gooch, architects. Like the Dun Building, this, too, is constructed of brick and terra cotta.

Plates 77, 78, 79, and 80. Dental Hall, University of Pennsylvania. The building, of which the exteriors and details only are given, is arranged in plan in two parallel parts connected by a staircase neck. The main portion is 50 ft. wide by 180 ft. long, the smaller wing is 48 by 85 ft.; these two are arranged on a central axis, and their difference in length accommodates itself to the lines of 33d Street and Locust Street, which intersect at an angle of about 50 degs. The larger building has its upper story devoted entirely to the operating room, in which are placed one hundred dental chairs. The back building contains an auditorium seating five hundred. The remainder of the floor space is given over to laboratories, examining rooms for patients, lecture rooms, students' assembly room, and quarters for the faculty and dean.

The structure is of slow-burning construction throughout with the exception of the roofs, where steel trusses are used. The heating is by steam and is supplemented by a special system of ventilation. Lighting throughout and power for operating the machinery of the laboratories is by electricity. These two are supplied from the main central heat and light station of the university. The exterior of the building is of brick laid in Flemish bond. The trimmings throughout are of terra-cotta, the roof of red tiles with cresting and lanterns of green copper.

The legislature of Illinois having passed a law providing for the licensing of architects and the regulation of the practise of architecture, the governor has appointed the following named gentlemen to act on the Board of Examiners: Mr. Dankmar Adler, of Chicago, the president of the board; Mr. Peter B. Wight, of Chicago, the secretary; Mr. William Reeves, of Peoria; Prof. N. Clifford Ricker, of the University of Illinois; and Mr. William Zimmerman, of Chicago. The board has chosen a committee on examinations, consisting of the president, and secretary, and Mr. Reeves, and will soon be ready to enter upon the performance of its duties.

The matter of licensing architects is receiving more or less serious consideration by the profession, and a committee of the institute has been appointed to investigate and report on the advisablity of adopting some such restriction. The most conservative opinion seems to be that the time has not yet arrived when such a plan could be carried out with sufficient thoroughness to be of any special value, either to the profession or the public. On the other hand, the fact remains that this matter is being agitated more or less by State and municipal governments, and that certain laws bearing on this question have been already passed in some places, which shows that within a comparatively short time the proposition must be met and settled in some way. Legislation affecting any profession should be controlled from within rather than from without, and while action may be temporarily deferred, the fact that certain restrictions, in many instances quite rigid, are now in force abroad shows plainly that some such measures are sure to be adopted sooner or later in this country, and also that it is important that the profession should keep the matter sufficiently well in hand to forestall any unreasonable action on the part of the law makers, who, when left to their own devices, are almost sure to impose some ill-considered and unjust measure. There appears to be a prejudice with some architects against the license idea, on the ground that it places them in an undignified and unprofessional position. But such objections can be easily disposed of by calling attention to the fact that both doctors and lawyers now practise under similar conditions to those under which it is proposed to place the architect.

At a meeting of the Executive Committee of the T Square Club, held September 17, a series of resolutions was adopted condemning the action of the State Capitol Commission in violating their agreement with competing architects, and in disregarding the recommendation of their own experts and the warnings of the Governor. The sentiment of the club is clearly shown in the following resolutions:—

"*Resolved*, That the architectural profession, and the citizens of this Commonwealth, are warned that the evident intention of a majority of the Commission to select an architect without reference to the terms of the contract they have made is a public scandal which calls for immediate correction.

"*Resolved*, That this Club pledges itself to the distinguished and honorable Board of Experts to uphold them and the reputable element in the profession in their protest against the disgraceful action of the majority of the Commission."

Brick versus Wood. III.

BY R. CLIPSTON STURGIS.

IN the preceding articles I have touched upon the advisability of using brick from motives of economy and beauty, and its adaptability to all kinds of work and all localities. I wish now to take up, perhaps, the most important part of the subject. How can a better and more frequent use of brick be encouraged?

ENTRANCE COURT, COOMBE WARREN.
George Devey, Architect.

First, I think, by more diffused knowledge. People generally do not appreciate, what I have, perhaps lamely, tried to show, how beautiful and appropriate brick is. They should learn why wood should not be used for any building which lays claim to dignity or importance, even if it be but the dignity of that lowly place a home, because, being perishable, it does not, cannot fulfil the demands made on it by such a building.

Then, wood being set aside, they should learn that the material which, other things being equal, is nearest at hand and cheapest to use is in most cases the best. This material is generally brick; where stone is handier or cheaper, then use it.

Wood is justified only in two ways; either because it is the only material available, or because land must be cleared of timber, and it is the easiest and least wasteful to keep the saw-mill going and build your buildings with the by-product of cultivation. Both these circumstances belong to a phase of life which we have happily outlived, at all events where architecture, as an art, exists.

If wood is used under the force of circumstances, it must ever be looked upon as a temporary expedient. It is not to the advantage of the present owner and indweller to live within wooden walls, and it is certainly not to the advantage of those who will follow him. It is not only that it is using a perishable material for a permanent purpose, thus endangering one's own household and your neighbors', but that one is using as a building material that which has other and, in many ways, more important uses.

For furniture, cabinet work, and innumerable small wares wood is indispensable, no other material can well replace it in these fields, and these are the natural markets for wood when cut. It is equally, I might say even more, useful standing, for it alone preserves us both from drought and from flood.

The great forests at the head waters of our rivers hold the winter snows and release them gradually to keep full the rivers, and to thus irrigate and fertilize the lowlands. Once remove these forests, and the spring sends the snows down in one mighty rush, to flood the country, devastating the land, leaving ruin in its track and drought to follow.

It is to the shame of our intelligence that we are so slow to waken to the necessity of husbanding our wood. We refuse to reserve our still wooded tracks, and we invite, yes, urge, wholesale destruction by putting prohibitive tariff on timbers from other countries. The folly of such a course seems inconceivable. When our hills are denuded it will be too late.

Thus while we are gratifying a perverted taste and building of wood we are endangering our own safety and that of our neighbors, and at the same time encouraging an industry which is fattening on the life blood of the country, in injuring its agricultural productiveness. There is no possible merit in encouraging this industry, for the trade in building lumber is not one which benefits the community at large, but one where the profits, unwholesomely large, go into a very small number of pockets.

As to the quality; this, of course, varies with localities, and in many places they have no reason to be ashamed of their common brick; but there are many kilns which turn out irregular and uneven brick, with great variations in size as between the hard burned and the soft. For this there seems to be but little excuse.

As to uniformity; there is now no standard brick, and if backing and facing are different, you must trust to luck for a bond here and there where the courses run level. This lack of uniformity is still worse from the architectural point of view, for in any given brick building the drawings cannot be made accurate until the builder has been settled upon, and he in turn has decided upon and bought his brick. Then only can you tell how thick a two-brick wall is, or how long a pier of four stretchers, or whether you can manage to make eight headers fill the four-stretcher space — nor can you course off your façade and tell how many courses high are your window openings.

No one but an architect can realize how intensely perplexing and annoying this is.

A uniform brick — at least for all common brick — would obviate this, and the uniform brick, of whatever size, should at least comply with the requirement of two headers and a joint equaling a stretcher.

Then, as to the steadiness of the supply. Some of our kilns are summer affairs, and only then can brick be made.

This is particularly discouraging in the very places where I think brick building should be encouraged. In the cities one can always depend on the large brickmaking centers where machinery is used, and the work is carried on regardless of weather; but in the

GARDEN FRONT, COOMBE WARREN.
George Devey, Architect.

country one must depend on local supply unless freight rates are favorable.

This is a most uneconomical way of doing business. To have

LUKE FIELD'S HOUSE, KENSINGTON.
R. N. Shaw, Architect.

a large piece of land, with buildings and machinery standing idle and profitless for six months, is not the way to produce cheaply. Apart from the business aspect, it is annoying to an architect or builder to find that when he is ready for brick he can't get them from the kiln he prefers because they are sold out, and no more can be made until the spring opens; or, perhaps he has got the plain brick and wants a few bullnose, or other simple molded brick made from the same clay, and he can't get them, but must use face brick with his common brick, and spoil them both.

But most important of all is it to get the cost brought down where brick can actually compete with wood, that is, the brick that must of necessity be used in the less expensive class of buildings; and this, I believe, is possible, and, in view of the certain rise in lumber, as our unfortunate forests are laid low, probable, too, and that at no very distant date.

A very common grade of brick, if they were of good proportion, would answer perfectly well for the cheaper class of buildings, and would be laid more quickly and to better advantage. The same would answer for backing, and would bond with the various superior bricks. One frequently meets with the absurdity of a higher price from a local kiln than the price, including freight, from a kiln two hundred miles away.

To sum up, I have tried to show how economical and beautiful the brick wall is, and how adapted it is to all situations, and have pointed out what seems to me the best methods of encouraging the use of brick; I can only hope that I may, at least, have opened up a line of thought among builders, architects, and brickmakers that may lead to action on this important subject.

I am aware that I have treated the subject very cursorily, and also keenly aware that I am attempting to give suggestions in a trade which I have never learned; it is only on the principle of judging by their fruits that I have dared to judge at all; but of this one thing I feel certain, that we are using wood too much in our building, and that some day we shall pay dearly for it.

The illustrations in this article have no immediate connection with the text further than exemplifying some good things in brick.

Coombe Warren was built fifteen years or so ago by the late George Devey for Bertram Currie, Esq., and although somewhat heavy in detail, it is virile and interesting — more so than much of the over-ornamented Italian Renaissance which we see so much to-day.

Morley's place is also by Devey; it stands on the site of an old house, "Hall Place," and has the advantage of retaining the old garden. With the rapid growth of vines and shrubs, and England's moist and mellow touch, it looks to-day almost like an old house.

MORLEY'S PLACE.
George Devey, Architect.

CHURCH FOR COLORED PEOPLE, BOSTON.

Luke Field's house, on Melbury Road, Kensington, is by Shaw, one of his most happy examples of the many houses for artists which he has built, so absolutely simple and homelike in appearance, and yet so distinctly fitted for its purpose.

The last illustration is a small church for colored people, built a few years ago in Boston.

Architectural Terra-Cotta.

BY THOMAS CUSACK.

(*Continued.*)

THE two Doric columns described in a preceding chapter were, we presume, introduced chiefly with the view of affording some visible means of support to the sub-cornice resting upon them. The word *visible* is used advisedly, for the invisible has been provided in the manner shown at Fig. 33. This occurs at the fourteenth

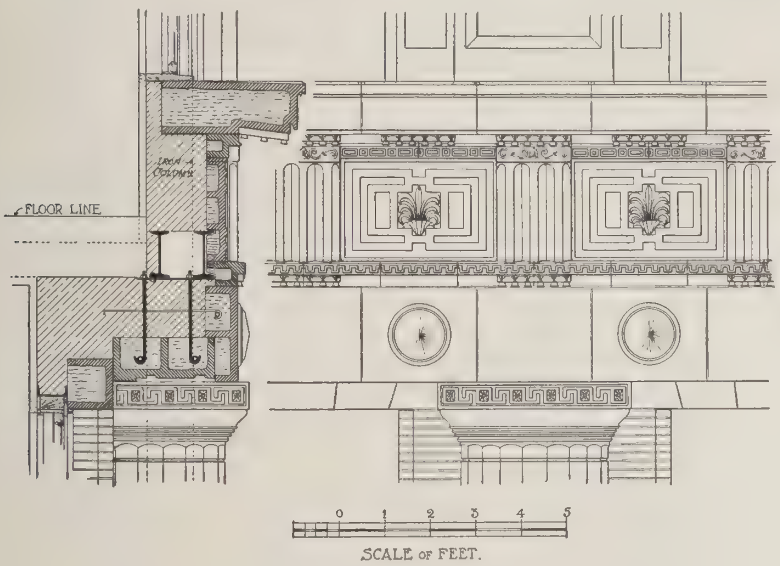


FIG. 33.

story of Fig. 34, which is the Central Syndicate Building, Broadway and Pearl Street, New York. The member referred to spans a recess of some depth, and of two stories in height, which, in its turn, becomes a central feature of the frontage overlooking that famous thoroughfare. Just why the least flexible of the classical orders should have been chosen, in an effort to clothe and embellish an avowedly unsympathetic anatomy of steel, would, we suppose, admit of more than one explanation. On that point, however, we are not inclined, at this moment, to hazard a conjecture. Suffice it to say that the effort *has* been made, and that, too, under circumstances sufficiently exacting to exhaust the resources, if they did not tax the complaisance of most architects.

Our concern at present is chiefly with the cornice, and most of what is said applies to the upper stories of this building. In dealing with these, there may be a doubt as to whether the designer had any very definite object in view; but the doubt is a reasonable one, and of it he shall have full benefit. We shall, therefore, assume that it was his intention to create, at an altitude of 200 ft., an effect proportionate to that obtained in classical examples at about one fifth of that height. If he has fallen short of this ideal, no one will attribute his failure to a lack of ambition. It was certainly a lofty one, however hopeless of attainment. He has not, it will be observed, attempted to do this by a relative enlargement of all the moldings, but by a redistribution and repeated use of the orthodox members, arbitrarily assigned to new situations. Thus we have the architrave, frieze, and cornice of the Doric order combined; and, as a single member of 6 ft. 8 ins., it is made to serve as an enlarged architrave. What would ordinarily have been the frieze is utilized as the fifteenth story; the piers taking the place of triglyphs, and the windows becoming metopes, minus the ornament. On top of these comes the actual cornice, with a projection of 5 ft. 9 ins., making a total of some 20 ft. from soffit of architrave, or about one tenth of the entire height from grade level.

What the ancients of Athens, or their less scrupulous successors of Rome might have done, or left undone, in the face of such a problem has been discussed with avidity among architects. This subject would seem to possess a peculiar fascination, and being still an unsettled one, it has been rediscussed by the wise men among them, with special reference to this building. Nine months or so have elapsed since its completion, and up until date of writing they have not, so far as is known, agreed upon a verdict. The prevalent impression is that upon so remote a contingency it would be idle to speculate, at which status, the question may be allowed a long rest.

The Greek architects belonged to a classical era in the world's history, while it is our lot to live in an age of iron. They had their own problems, which they solved to their own satisfaction, and to the admiration of succeeding ages. Their talents found sufficient vent in the pursuit of subtle refinements, and when these reached the acme of human perfection "a deep sleep" fell upon them. Should they awake in this commercial age, the perplexities of the situation might worry them more than they appear to have done the up-to-date designer of this modern office building. He, we doubt not, consoles himself with the reflection that they have been a long while dead, and so are not likely to turn in their sarcophagi over this latest, though not least daring transposition of their exquisite detail.

In consideration of what has been said, we give a number of details, as drawn from the models, all of them giving an accurate representation of the work as executed. Most of these may be left to speak for themselves. In the main cornice (Fig. 38) certain peculiarities in the design made it necessary to devise a somewhat different method of construction from that shown in previous examples. This change is made imperative by the absence of modillions, which, among other things, served to conceal the inverted ⊥s, heretofore used as cantilevers. The whole of the soffit being now exposed, the iron supports must be inserted some distance from the surface. Instead of ⊥ sections we now find it expedient to use 5 in. 12 lb. I beams, for which an exact counterpart is molded in the ends of each block. These soffit blocks are made in one piece, with a hole in the center, into which the rosette is keyed at the time of setting. In the setting, too, of this cornice, different methods of procedure must be resorted to. Of these we know of but two that are practicable, and between them there is little room for choice.

If it be decided to space the cantilevers and make permanent riveted connections with the structural ironwork, that may be done before the walls have reached their full height. They must, in that case, be spaced accurately to the dimensions furnished by, or previously agreed to with the terra-cotta maker, who, meanwhile, has his work too far advanced to admit of material alteration. It may be that he has it made, perhaps fitted to these figures, and ready for shipping on demand. They should likewise extend at right angles to the building line, resting on an unyielding fulcrum, and be adjusted to perfect alignment. We have reason to know that these fundamental conditions do not always receive the attention that their importance demands. The drawings supplied for this purpose may be complete, and as perfect as it is possible to make them; it does not by any means follow that the erection of the work

FIG. 34.

will be equally so. The iron-workers, at least, have a stable material on which correct measurements may be made, and the holes punched, or, when necessary, drilled with mathematical exactness. This, of course, calls for reasonable care and consideration on their part; two qualities which they should be encouraged to cultivate. We are very far from saying that they are the only class of workmen to be met with on buildings who are wont to excuse themselves by the use of a well-worn "near enough" or "good enough." It is, nevertheless, a fact that they use these exploded maxims, and, what is worse, appear to act upon them far too frequently. A more rigid supervision is certainly required in such matters, and where other influences fail, the contracting engineer should be held to strict account by the architect. A few elementary lessons would not be amiss, as an aid to memory, the more salutary if of a pecuniary character, and taught him at his own expense.

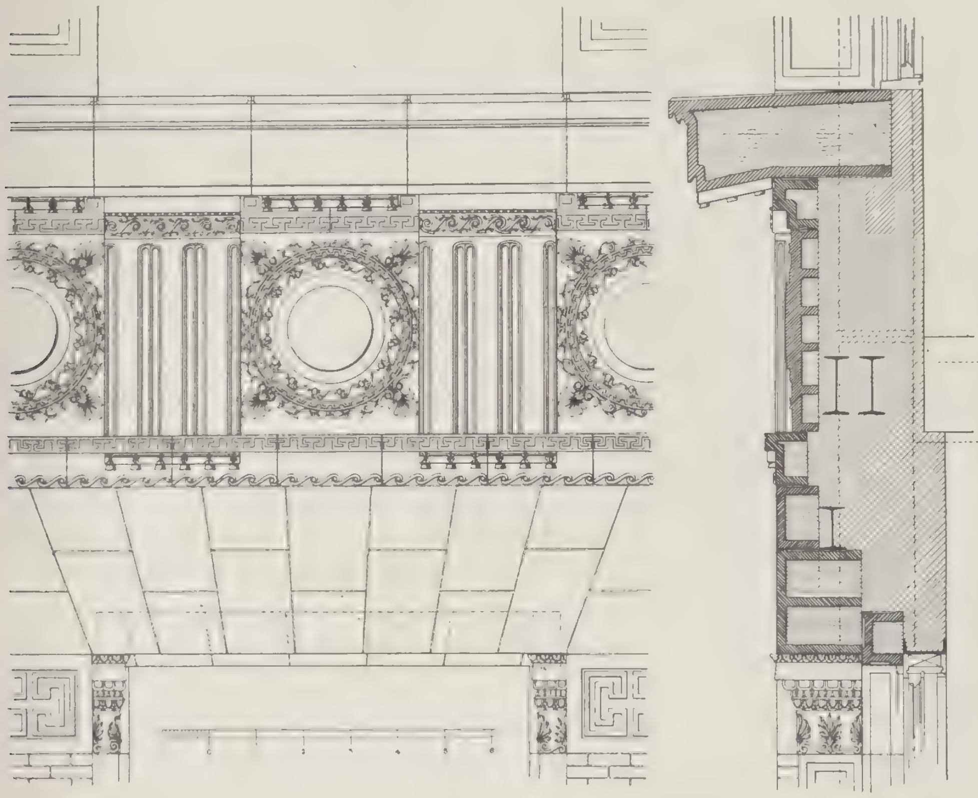


FIG. 35. CORNICE BETWEEN 4TH AND 5TH STORIES.

Assuming, for the moment, that the ironworkers have done their part intelligently, the same thing will be expected from the men entrusted with the setting of the terra-cotta. Their first requisite is a scaffold of extra width, and, it may be added, of extra strength, in order that the blocks may swing clear of the cantilevers and then slide in between them. When this plan is adopted the chief drawback encountered is in getting sufficient mortar into the vertical joints. We fear there are cases where this difficulty was deemed a sufficient excuse for setting them dry. The terra-cotta manufacturer, however, can do much to invalidate this pretext by providing vertical grooves in the ends of the blocks. Into these, cement grout should be run; it will find its way down as far as the iron, for which it will be a preservative, at the same time filling most of the interstices.

The other, and perhaps better, plan is to have all the cantilevers fitted and marked for their respective places, but not fastened. As each block of terra-cotta is bedded in position it is followed simultaneously by a cantilever, which may be held in place temporarily by a bolt, to be replaced by the usual rivets as soon as convenient. This allows mortar of sufficient stiffness to be spread on each end of the block, which, when pushed together on the iron, leaves no unfilled crevices in the joint. But, whichever plan happens to be adopted, no extraordinary effort is presupposed, much less demanded, from anybody concerned. In addition to the skill which most workmen claim as their stock in trade, a reasonable amount of cooperation and helpfulness is all that is needed. This, if not expressly stipulated in every specification, is tacitly understood, and is the essence of every contract.

Beyond the points that have been suggested, there is but one criticism to make in connection with this cornice, and it, though the last, is not the least important. The lions' heads on the corona are much too plentiful. They are good enough things in themselves, but it will be seen how easy it is to have too much of a good thing. A head on every third block would have been ample, and in this respect our example of last month comes much nearer to the right disposition. Most of the moldings introduced into the soffit are too small, and, consequently, also too numerous. These small undercut members were put in at considerable expense to the manufacturer, and the most regrettable part of it is that when viewed from the street they represent nothing, unless it may be so much wasted effort. Ruskin was thinking prospectively as well as retrospectively when he wrote of things such as this being "fused together in nebulous aggregation." Fewer and bolder members, with sufficient cinctures to give relief, would, we think, have been a decided improvement, and these could have been had for the asking. The foregoing are faults for which no excuse can be offered, but if it be any satisfaction to those responsible for them, we will say that they are in what may be considered good company, architecturally. Such failings, if not common, are certainly not confined to this building. We know of cases in which the size of the members began to diminish in inverse ratio to their height in the building. The smallest leaf used by one eminent member of the profession was withheld from the entrance vestibule and reserved as an enrichment for coping on the parapet.

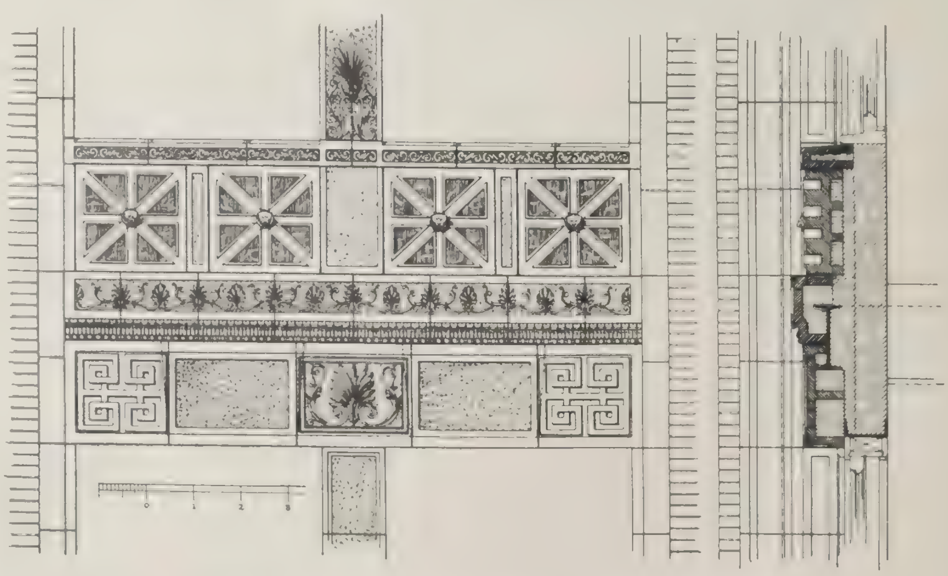


FIG. 36. TRANSOM IN WINDOWS BETWEEN 4TH AND 5TH STORIES.

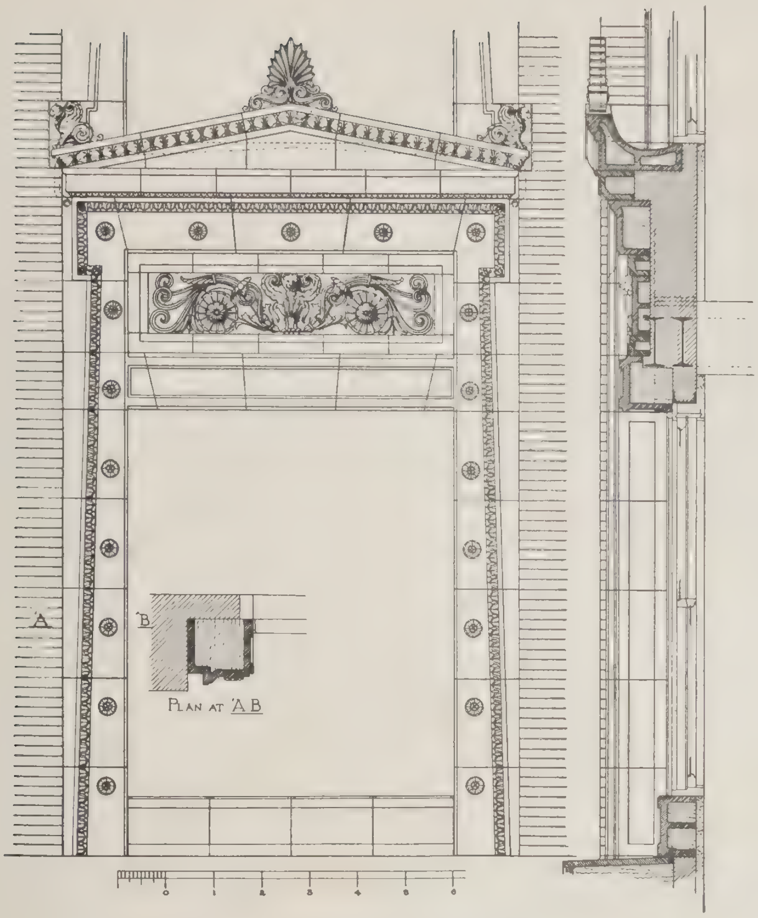


FIG. 37. WINDOWS IN 12FTH STORY.

It is difficult to account for this well-nigh unaccountable tendency. One explanation may be found in the fact that the average draughtsman views his work at too short a range, viz., the drawing board. Let the physical eye follow the lines that are being made on paper, by all means, but let the mental vision soar to higher altitudes, and there picture the complete work *before the foundations have been dug*, proportioning each detail to what it should appear when placed at any given height in the building.

BRICK EFFLORESCENCE.

A GERMAN'S OPINION.

THE incrustation or efflorescence of bricks and brickwork through weathering formed the subject of an inaugural address by Professor Gunther at the University of Rostock, North Germany. Mineral incrustations on walls are mostly white or grayish, more rarely yellow or green — these latter being due to vanadium, a silvery brittle metal of rare occurrence. In appearance these incrustations vary, according to the solubility of the component salts, from floury or wooly powders to stalactitic masses; and they may result from various causes present either in the raw clay or introduced in the water employed in brickmaking, or from pyrites in the clay or fuel, or from the ash of the latter material; and the infiltration of soluble substances from the mortar, or combination of the alkalis in the latter with the gypsum in the bricks; or, finally, the absorption of nitrates from the soil and from the air of ammonia or sodium chlorate (near the sea) may give rise to incrustation. Incrustation may come either from the bricks or from the mortar. While incrustations of calcium carbonate do no harm beyond spoiling the appearance of the work, soluble alkali salts repeatedly dissolve and recrystallize in the cracks — ultimately producing disintegration. To prevent these incrustations, pyrites, and sulphates can either be removed by the slow process of seasoning the clay by prolonged exposure to the weather before making up into bricks, or by adding barium salts to the clay before burning, so as to produce the insoluble barium sulphate. Bricks should be very thoroughly burnt, since in this state they are less disposed to absorb the moisture necessary for the extraction of the soluble salts. — *The British Brickbuilder.*

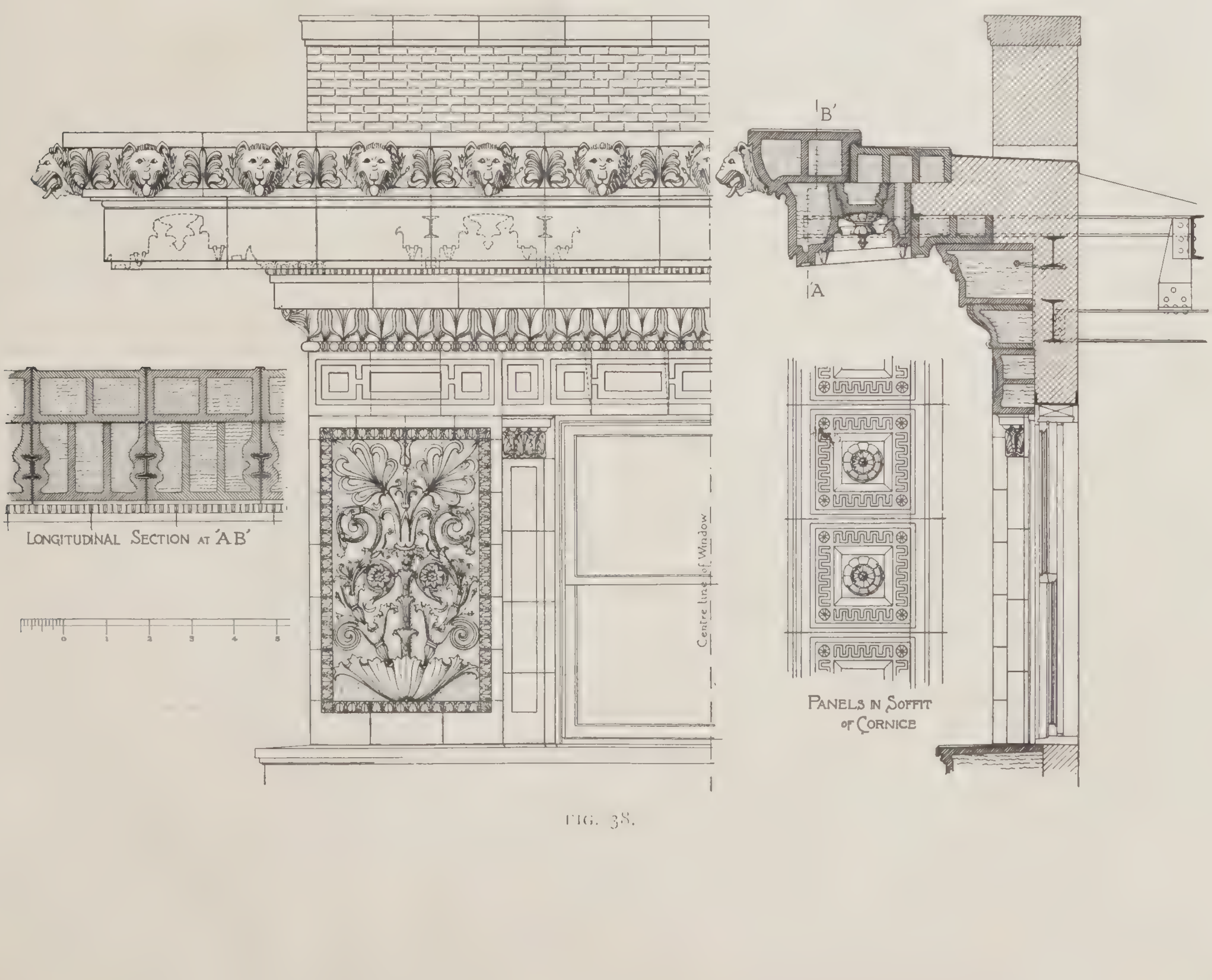


FIG. 38.

The Art of Building among the Romans.

Translated from the French of AUGUSTE CHOISY by Arthur J. Dillon.

PART III.

CHAPTER II.

THE ART OF BUILDING AND THE ORGANIZATION OF THE WORKING CLASSES.

I HAVE reviewed the principal epochs of the history of Roman construction, and the circumstances that attach it to the history of the empire. I now wish to go a step farther, and, without stopping over the exterior causes that in turn hastened or retarded the progress of the art of building, go back to the influences which the interior organization of society has in its methods. What part had free labor? What part had slavery? In what ways, from what parts of the people, were procured the thousands of workmen who built the monuments of Rome? In what way could their efforts be utilized, and what were the practical methods that were consequently preferable? All these questions are related to each other. The condition of the working classes is shown in the construction of the edifices as plainly as the Roman customs are shown in their plans; and the principal interest in the study of construction would be lacking if the account of the methods were separated from the account of the institutions that explain and justify them.[1]

One institution, among others, whose name constantly recurs in the Roman laws and inscriptions is that of the corporations or colleges of workmen; strange associations, the details of whose regulations, unfortunately, the ancients failed to transmit to us, and whose history must be sought by the difficult comparison of scattered documents. Sometimes a concession of privileges, sometimes a law on public taxes, gives us a trace of their immunities or their obligations; one inscription gives us a glimpse, in lists of titles as obscure as they are numerous, of a complex hierarchy established in each of the corporations; another inscription reveals, in fragmentary sentences, a series of statutes freely accepted by the corporations, regulating the relations of the different members. These are truly very incomplete documents, but in spite of the unfortunate vagueness of many of them, the general impression obtained from a review of the whole mass is of a certain clearness; and one fact of capital importance seems to be shown by this incomplete evidence; it is the existence of a working class, widely separated from the rest of Roman society, and placed, by an hierarchial organization and by a system of privileges and duties, in the hands of the emperors.

Moreover, this organization is of recent date. Before becoming an instrument of the centralized imperial power, the workingmen's corporations had a long struggle to obtain recognition of their existence and sanction of their franchises; a struggle which commenced with the first days of Rome, and which was prolonged with varying fortunes for a period of nearly eight centuries; for it was only under Hadrian that the corporations finally took a definite rank among the recognized institutions, and commenced to play that important part in the internal economy of the empire that was henceforward to be theirs.

The origin of the workingmen's corporations is confounded with that of the Roman state; perhaps their creation must even be placed among those numerous things borrowed from Etruria in that period of peaceful organization to which historians give the name of Numa. Afterwards, when the attention of the Romans was again turned to war, the institution, temporarily overthrown, rose in a new form; the corporations that were able to assist in military works, in the equipment of the armies, in the manufacture and the maneuvering of the engines of war, became the important ones, and when the people were classed by centuries, the power of these corporations was so great that by themselves they formed two centuries, voting in the *comitia* with the first class of Roman citizens. This privilege, to be sure, was enjoyed by a large number of corporations which we could not investigate without going beyond the natural limits of this study, but there are several of them in which we are particularly interested; among others, those who worked in metal and wood took rank in these half-military societies, which, according to the expression of Titus Livius, were soldiers by trade, though they did not bear arms.[2]

The example of these first corporations, the ever-increasing influence that they had in the Roman society greatly increased the tendency toward association among the working classes, and little by little all the trades of Rome were organized as corporations under regulations that made them similar in varying degrees to the corporations instituted by Numa and Tulla. Objectionable above all to the last Tarquins, and to the aristocratic government that followed the expulsion of those kings, the existence of these popular confederations was more than once in question;[3] but the spirit of association prevailed over the prohibitions of the patricians to such an extent that at the last years of the republic the whole of the workmen of Rome were formed into free societies, strongly constituted, and having, with or without the consent of the government, an organization that, to a certain degree, put them beyond the control of the central authority.

It would appear that the material advantages were rather the pretext than the real basis of these unions, and about the time of the civil commotions that preceded Augustus, the interests of the factions into which the Roman world was divided gave the workingmen's corporations one of the principal elements of their power. They were animated by a seditious spirit, and numerous revolts (in which the name of Clodius, it is said, was mixed) finally moved the Roman government to a distrust of the principles themselves of these institutions. Prohibited under the rule of Cicero, in spite of the support they had formerly given him, the corporations were reestablished by Clodius, who increased their number, admitted foreigners, and even slaves, and increased in them the unquiet spirit which forced Julius Cæsar to again suppress them.[4] Only a few exceptions were made, through respect of ancient traditions, or on account of regard for general needs. The fate of the corporations who took part in construction, whether they were comprised in the condemnation, or whether their ancient origin and the importance of their services placed them in the small number of corporations which, the documents say, were spared for the public good, is not known.

[1] Besides the original texts to which I refer, the following works can be consulted in relation to the questions which are the subject of this chapter: —

Heineccius, De collegiis et corporibus opificum (a dissertation reproduced in the collection called Opusculorum variorum sylloge)

Serrigny, Droit public et administratif romain.

Th. Mommsen, De collegiis et sodaliciis Romanorum (Kiliæ, 1843).

Rabanais, Recherches sur les Dendrophores (Bordeaux, 1841).

Roth, De re municipali Romanorum libri II. (Stuttgart, 1801).

But kindly advice has assisted me more than these learned works, and I beg to acknowledge my gratitude to M. Egger for direction he gave to my researches.

[2] The original documents on the origin of these corporations are these: —

1st. Establishment of the corporations under Numa as peaceful organizations.

Plut., Numa, Cap. XV.

Plin., Hist. Nat., Lib. XXXIV., Cap. I.

2d. Transformation of many corporations into semi-military institutions, under Tulla.

Dinoys. Halic., Ant. rom., Lib. IV., Cap. XVII.

Tit. Liv., Lib. I., Cap. XLIII

3d. Persistence of distinctions in favor of the corporations who aided the armies.

Digest., Lib. I., tit. VI., l. 6 (taken from a treatise, "Militarum," written about the time of Commodius).

Among the concordant works on these documents, see the dissertation of Heineccius, "De orig. et jure coll. et corp. apud Rom.," and that of M. Mommsen, "De coll. et sodaliciis," p. 27, et seq.)

[3] Heineccius, "De orig. et jure coll.," Cap. I., § 9.

[4] Some of the documents on which these statements are founded are these: —

1st. Suppression of the corporations by Cicero.

Asconius, in Corneliana Ciceronis, edit. Orelli, p. 75.

(Cf. Cic., Pro domo, Cap. XXVIII.; and Q. Cic. De petitione consul., Cap. I.)

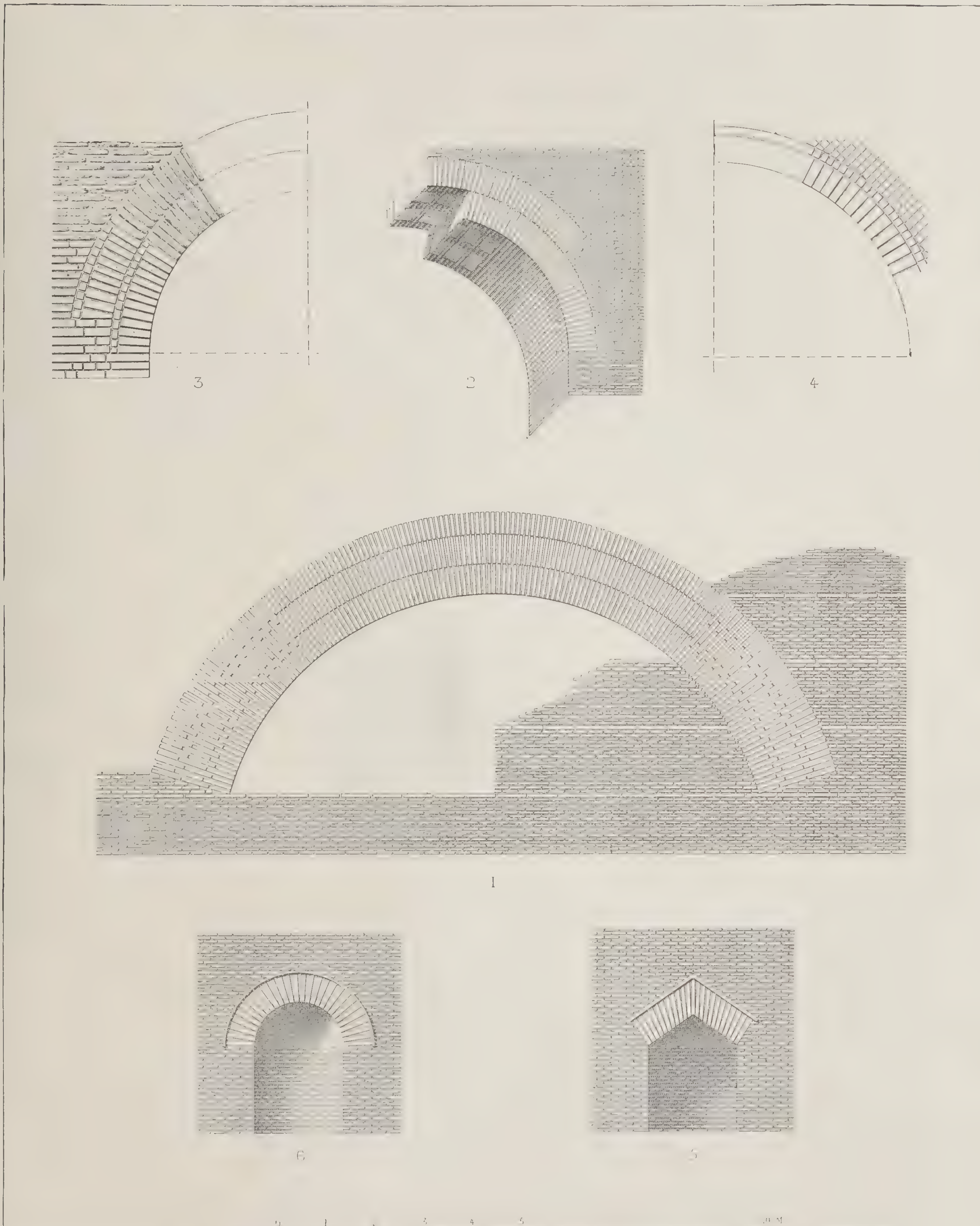
2d. Reestablishment by Clodius: —

Cic., in Pisonem, Cap. IV.

3d. Suppression by Julius Cæsar;

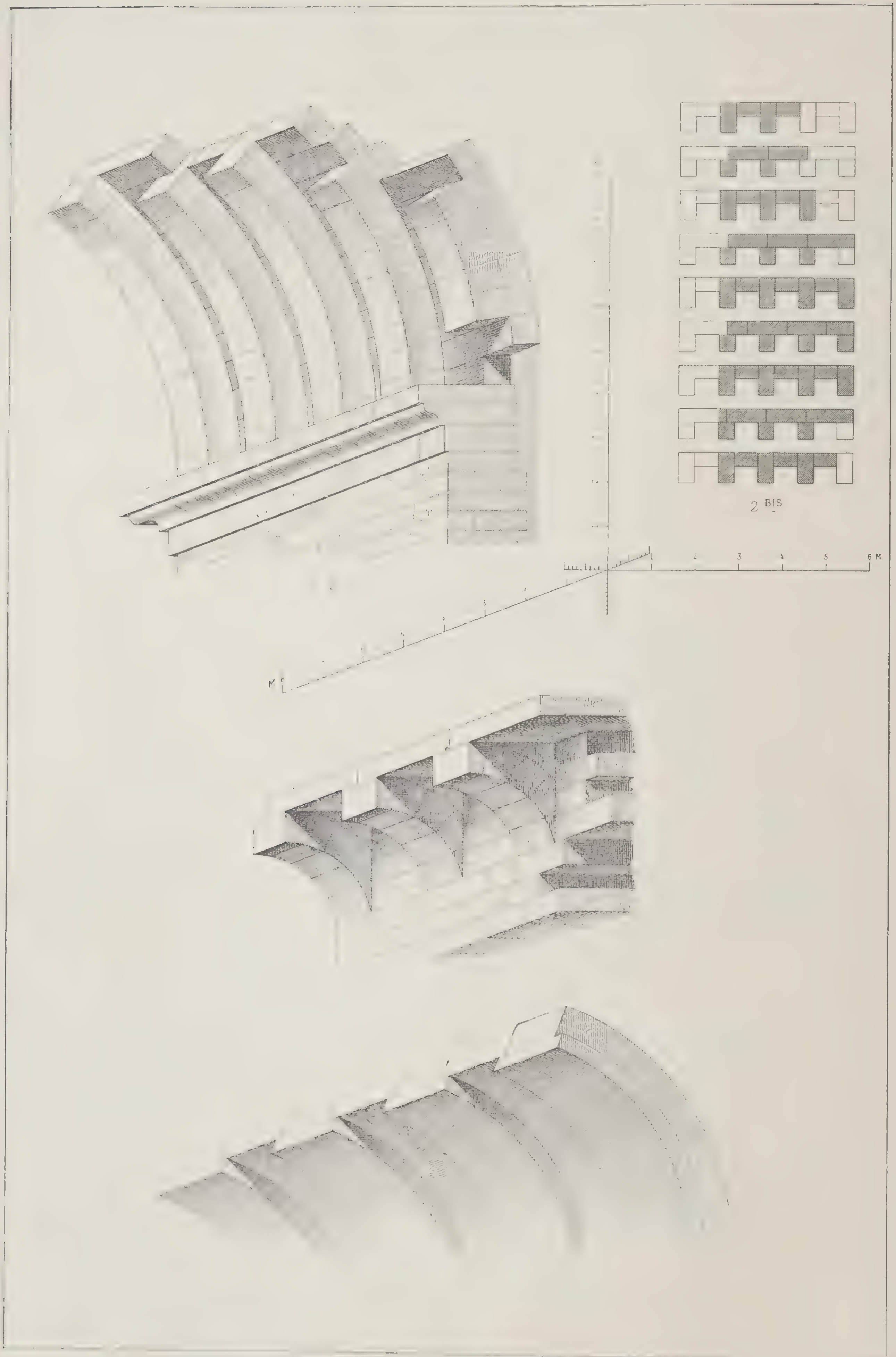
Suet., Jul., Cap. XLII.

(For the discussion of these documents see the memoir of M. Mommsen.)



1. PANTHEON. 5–6. TAORMINE.

PLATE XV. THE ART OF BUILDING AMONG THE ROMANS.



1. Bains de Diane a Nimes. 2 and 2 Bis. Point de Narni.
PLATE XVI. THE ART OF BUILDING AMONG THE ROMANS.

However that may be, the frequency of the edicts published against the corporations during the period of a century shows what permanence the idea of association had. From Julius Cæsar to the Emperor Claudius, three successive edicts confirm in turn the first interdictions.[1] Finally renouncing the direct contest against a tendency that increased in proportion to the efforts opposed to it, the emperors, little by little, placed themselves at the head of the corporations, and in order to dominate them, they profited, it seems, by the religious character which was found, as well as the idea of association, and the partisan spirit was found in them.

Nero had himself made a priest of all the corporations tolerated in Rome,[2] and a great number of the corporations that had been overthrown were reconstituted under the open patronage and the somewhat perfidious protection of the pontifical power of the Cæsars. But the direction given to the workingmen's corporations by the supreme authority was not sufficient to stifle the fear of them for any long period. Trajan tried, but in vain, to revive the ancient interdictions; and during the first years of the second century there is the singular spectacle of a Roman emperor compelled to recognize in Rome the unions he is endeavoring to suppress in the provinces.[3]

Hadrian was the first to understand the fruitlessness of the effort to stop the movement. He abandoned both the idea of suppressing the corporations and that of transforming them into simply religious societies; they seemed to him to afford valuable resources for the execution of the great edifices he was planning; he saw in them a powerful instrument which he strove to put to profit in the interest of his vast enterprises. Henceforward the workingmen's corporations lost their primitive character of free associations and became official institutions of the State, a fundamental change which marked, for the greater part of the working classes, the point of departure of an entirely new régime, of a condition of affairs whose developments fill the long period that elapsed from Hadrian to Theodorus.[4]

The new condition imposed on the corporations of builders is indicated in a few historical texts, but it is most plainly marked in the regulation of Antoninus and his successors, while the definite form it took in the last period of the empire is shown in numerous texts preserved in the Theodosian Legislation. Aurelius Victor says (epit., cap. XIV.) that Hadrian has enrolled the building trades in cohorts, organized after the model of those of the armies. "Ad specimen legionum militarium, fabros, perpendiculatoris, architectos, genusque cunctum exstruendorum mucnium seu decorandum, in cohortis centuriaverat."[5]

This testimony is made clearer, though the well-defined, original form leaves no room for doubt, by regulations which may be attributed to the immediate successor of Hadrian. The jurisconsult Callistratus expresses himself thus, in summing up the measures taken by Antonine Pius in regard to the corporations: —

"To certain corporations . . . immunity is granted; these corporations are those to which admission is obtained by virtue of a trade, such as the corporation of smiths, and all those which have a similar origin, that is to say, which were established to give the aid necessary to enterprises of public utility. . . ." "Quibusdam collegiis vel corporibus quibus jus cœundi permissum est, immunitas tribuitur: Scilicet eis collegis vel corporibus in quibus artifici sui causaunus — quisque adsumitur: ut faborum corpus est, et si qua eamdem rationem originis habent, id est idcirco instituta sunt, ut necessariam operam publicis utilitatibus exhiberent," etc. (Digest., Lib., tit. VI., l. 5, 12).[6]

I thought I should give this curious document in its entirety, for it defines both the kind of servitude imposed on the corporations and the reasons for giving the privileges that were granted to them in return. The privileges enjoyed by the corporations were above all a recompense for the duties that weighed on them. The emperors had to recompense by indemnities the extremely onerous obligations that bound the members of a corporation to give their services in this manner whenever a public necessity demanded their assistance.

This was the fundamental idea on which the workingmen's corporations rested, but it will be of interest to go beyond this generality, and endeavor to fix the nature of the requisitions which their members were compelled to meet, the character of their immunities, and the principal points of their internal organization.

The servitude imposed on the corporations did not consist of the obligation of giving their work to the State gratuitously, but only of the obligation of giving it; it was an infringement of personal liberty, nothing more, but none the less a serious infringement when judged either by the importance of the compensation given for it, or by the severity of the penalties decreed against the members of corporations who should endeavor to escape the charges put on them by flight.[7]

It was no less a matter than that of placing one's self absolutely at the discretion of the State, of continually residing at the place where the corporation did its work, and of accepting as the price for these services whatever the State was pleased to grant. It was, as can be seen, essentially a dependent condition that has more than one point in common with that of the Roman colonists, or, better still, with that of those singular dignitaries of the last days of the empire, who, under the name of curials, were given honorary duties under ruinous conditions by the despotic emperors. Looked at from no matter what point of view, Roman society seems to have been based entirely on a system of servitude partially repaid by privileges.

But the members of the corporations were more fortunate in this respect than the classes to which we have just compared them, for the immunities granted to them in return for their heavy obligations were a less illusory compensation. Their privileges consisted in their absolute exemption from all public taxes, from all municipal duties, and from all extraordinary imposts; they were not subject to the corvée, nor to military service, and were entirely free from the burdensome impositions which, under an infinite variety of names, crushed the other classes of Roman society.[8]

Apart from these advantages, the workingmen's corporations received from the State a gift of lands whose revenue was included in the remuneration for their services. The lands comprised in these

[1] 1st. Under Julius Cæsar; Suet., Jul., Cap. XLII.
2d. Under Augustus; Suet., Aug., Cap. XXXII.
3d. Under Claudius; Dio. Cass., Lib. LX., Cap. VI.
(This last document seems also to indicate the commencement of tolerance on the part of the predecessor of Claudius.)

[2] Orelli, Inscript. lat., No. 764 (note); I have taken this from the paper of M. Belin de Launay in the Acts of the Acad. de Bordeaux, 1867, 1er tri.

[3] Prohibitions: Plin., epist., Lib. X., 42 and 43. Recognized corporations: Aurel. Vict., De Cæsarib , Cap. XIII.

[4] It may be said in passing, that this change in the character of the corporations, which commenced by being tolerated and ended in being obligatory, explains a certain lack of agreement between the juridical documents in the Digest. Taking the oldest of these texts, those of Gaius, for example, the workingmen's corporations are almost invariably presented as tolerated associations (see in particular Dig., Lib. III., tit. IV., l. 1). On the contrary, taking the constitutions of the fourth and fifth centuries, they all imply a different character to the corporations, that of obligatory associations. The means of compulsion which are cited farther on belong to this period, and sufficiently mark the nature and importance of the transformation that was made.

[5] "He had enrolled as cohorts, according to the model of the military legions, the smiths, terracers, the architects, and all that group of artisans who build or decorate.

[6] This enunciation, taken from a jurisconsult of the second century, is enlarged upon, and made still clearer by Majorien, who shows us all the members of the corporations compelled to live in their own cities in order to work for the public benefit in turn (*alternis vicibus*) and at the request of the curiales (*pro curialium dispositione*): Nov. Theod., Lib. IV., tit. I. This is the text of the constitution: "De collegiatis vero illa servanda sunt, quæ præcedentium legum præcipit auctoritas. Quibus illud provisio nostræ serenitatis adjungit, ut collegiatas operas patriæ alternis vicibus pro curialium dispositione præbentibus, extra territorium civitatis suæ habitare non liceat."

[7] Novell. Maj., previously cited, is a sufficient proof of this (Nov. Maj., tit. I); furthermore, it may be confirmed by these works: —
Novell. Theod., Lib. I., tit. XXVI.
Cod. Theod., Lib. XIV., tit. II., l. 4. Lib. XIV., tit. VII., l. 1. Lib. VI., tit. XXX., l. 16.

[8] 1st. Exemption from military service. Novell. Theod., Lib. I., tit. XXVI.
2d. Exemption from municipal duties. This is at least probably established by Cod. Theod., Lib. XII., tit. I., where the two kinds of duties seem to be considered equivalent.
3d. Exemption from taxes or extraordinary imposts. Cod. Theod., Lib. XIV., tit. II., l. 2.
4th. Exemption of minors. Digest., Lib. XXVII., tit. I., l. 17, § 2.

donations, the *fundi dotales*, divided between the members of the corporations, became their individual property, transferable, like other possessions, by inheritance, and it was on account of the importance of the donation that the charges upon them were divided among the different members of the corporation. Each contributed to the service of the State in proportion to the part he held of these lands so heavily encumbered, and the obligations were transferred with the property itself.[1]

Several important consequences were brought about by this, for when the endowment passed from a member of a college to his children, the obligation of fulfilling the public duties would also be hereditary, and by this reasoning, which, in spite of its unfortunate results, was correct, it followed that the Romans found themselves compelled to attach the workingman to his corporation, and to perpetuate a servitude which took from the son of a Roman workingman the right to choose his mode of life, and to select his occupation according to his taste or his needs.

The natural solution would have been to give a choice between assuming the duties of the corporation or abandoning the endowment; and this did not escape the attention of the logical and penetrating minds of the Roman law makers. The terms of the law in this respect are precise, and contain, one might say, the entire theory of the servitude imposed on the workingmen's corporations. "Those who hold under any title whatever, property subject to the charges of corporations, whether they have obtained possession by purchase, gift, or in any other manner, must either take the charges on themselves in proportion to the value of the property or else must give up possession" (Cod. Theod., Lib. XIV., tit. IV., l. 8), and the law adds, this also covers "all the corporations that share in the privileges of the city of Rome."[2]

But it is to be feared that this law, which seems a safeguard of individual liberty, was only one of those speculative matters from which Roman legislation is not free; there is no doubt that in more than one case the strict deductions were put aside at the exigency of certain less favored corporations that had become, through long custom, necessary organs of the imperial administration. The emperors arrogated the right of placing citizens in the corporations on their own authority, and of transferring members of one corporation to another; and, above all, as though they feared a lack of members, forced membership in those corporations whose duties were the most burdensome was made a legal penalty.[3]

Thus, by means of a wisely tyrannical discipline the Roman government provided for the general necessities of public works and for the provisioning of the large cities. The workman or merchant of the Roman empire was not an independent citizen who worked according to his own will to supply his own daily needs; he was a functionary of the centralized government, receiving, in the form of revenue from an endowment, a regular salary, and bound to deliver, in exchange for this revenue, this salary, the result of his labor either to the State or to the municipality. The State, through its endowed employees, produced directly the provisions necessary for the support of the people (*pistores*, *suari*, etc.), undertook all transportation (*navicularii*, *vecturarii*, etc.), and built its monuments (*structoris*, *tiguarii*, *fabri*, etc.); a strange system which wiped out private enterprise and competition, and which substituted for the spontaneous workings of industry, the machinery of an immense administrative hierarchy which commenced at the emperors and ended at the lowest workman of the large cities.

It can be seen that it would be a serious error to regard the services of the corporations as gratuitous; their endowments and their privileges were a first recompense, but they had also in many cases a further one which was regulated entirely by the importance of the services rendered. I found the proof of this in the curious constitutions that regulated the corporation that was bound to supply Rome with the lime necessary for its buildings, the "*calcis coctores*." Their pay, following a widespread custom of the empire, was not in money but in kind, an amphora of wine for three wagons of lime; the carters who transported the lime (also functionaries of the Roman administration) received an amphora of wine for every 2,900 lbs. of lime, not including the income from their endowed lands, and the produce of three hundred oxen given to their corporation (Cod. Theod., Lib. XIV., tit. VI., l. 1).

It seems, then, that the Roman society recognized the state of subjection which it imposed on the corporations by immunities or permanent gifts, and recompensed each service rendered by a special salary. These benefits, however, reasonable and seemingly equitable, were far from being sufficient to repay the services at their true value; they were, as the Code says, but consolations (*solatium*)[4] which served to lighten the heavy obligations. The State reserved the right of fixing the payments of the forced contractors of its works, and the amounts it paid were but a small recompense, and dissimulated but poorly the semi-slavery. The greater part of the expenses of the city were in reality borne by the corporations; and, to use the language that was used by an illustrious Roman citizen in a petition to the Emperor, "The ancient privileges were bought at a great price; their so-called immunities are paid for by perpetual slavery."[5]

(*Continued.*)

FREEZING TEST FOR BRICKS.

ONE of the most important features in structural materials of all kinds is their permanence under the influence of atmospheric influences. Of all these perhaps the one that exercises the greatest mechanical effect is frost, which tends to disintegrate bricks and stone by the expansion in the act of freezing of the water enclosed in the pores, with a consequent separation of particles or flakes when thawing ensues. Probably very few of your readers have ever thought of testing the permanency of their goods under such conditions; the winter time provides a seasonable opportunity, and there is no reason why every manufacturer should not, if we have frost enough, be able to ascertain to what extent his goods will stand frost. This can be determined by a very simple test, namely, by direct freezing. Let typical samples of the goods be chosen during frosty weather, and saturated with water, and then alternately frozen and thawed a dozen times or more. Now, if the samples to be tested are weighed dry, and the loss of weight by exfoliation determined also on the dry samples, the thing is accomplished. It would be possible to create a standard of permanency by counting a given percentage of loss as unity (this would have to be chosen arbitrarily) and then referring other percentages of loss to it. Thus might be created a scale of permanency, and when about to enter into a contract, this might be referred to just in the same way as the resistance to crushing strain is now quoted.—*British Brickbuilder.*

[1] Cod. Theod., Lib. XIV., tit. III., l. 7, 13, 19; tit. IV., l. 8.

The working of this system of donations and duties can be observed by reading the applications the Romans made of it to two of their principal corporations, the *naviculare* and the *pistores*; each of these applications, each of these monographs, as they may be called, is the subject of a special title in the Theodosian Code.

Taking the expressions of the Code exactly, two meanings may be given to the words *fundi dotales*. The donation to the corporations could be a complete abandonment of certain property to their members, or it could be simply the exemption from charges of land held by them. These two hypotheses, neither of which, moreover, excludes the other, carry the same consequences as far as the legal position of the collegiati and the character of their remuneration is concerned: whether the members of the corporations had the revenue of the donated lands as an indemnity, or whether the *fundi dotales* was simply the partial or complete exemption from all imposts entailed by the possession of such lands, the principal remains the same and the conclusions we are brought to remain true.

[2] "Hi vero qui prædia obnoxia corpori, vel ex empto, vel ex donato, vel ex quo libet titulo tenent, pro rata publicum munus agnoscant, aut possessionibus cedunt. Circa reliqua etiam corpora, quæ ad privilegia Urbis Romæ pertinere noscuntur, eadem præcepti nostri forma servetur."

[3] For the participation of citizens in the corporations, and the right of transferring the members of one corporation to another, see Symmach., Lib. X., ep. 58.

For the grade of the condemnation that placed free citizens in certain corporations whose duties were onerous, see Cod. Theod., Lib. IX., tit. XL., l. 5; Lib. XIV, 10, tit. III, l. 23, etc.

[4] Cod. Theod., Lib. XIV, tit. III, l. 19.

[5] Symmach., Lib. X., ep. 27: The "report" from which I took this citation forms one of the most interesting and most complete pictures the ancients have left us of the position and condition of the corporations of the workingmen of the Roman empire.

Fire-proofing Department.

DETAILS OF FIRE-PROOF CONSTRUCTION WITH BURNED CLAY.

BY PETER B. WIGHT.

PARTITIONS AND WALL FURRING.

HOLLOW-TILE building blocks were invented and patented in this country by the late George H. Johnson, about the year 1872, the purpose of the invention being to construct round or square grain bins in elevators; though numerous forms of rectangular hollow blocks had been made in France before that time. The feature of Mr. Johnson's invention was to cramp the blocks together with burned clay cramps, the blocks being set on end. Thus when the courses were set with broken joints the cramps were concealed. An added strength was thus given to grain bins which are subject to great lateral thrusts. But the invention was of doubtful utility and added to the expense of partition work when used in buildings. It was used for a considerable time by the company which continued Mr. Johnson's work in Chicago, but has since been abandoned. One of these partitions is shown in Fig. 1.

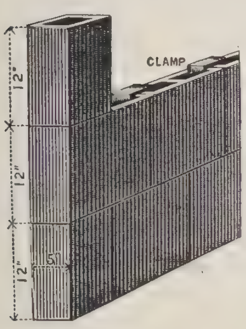


FIG. 1.

The first hollow block used for partitions in New York and the Eastern States in the early 70's was 4 by 6 by 12 ins. in size, with two longitudinal holes. The thickness of the clay was ⅝ in. for hard tile and ⅞ in. for porous tile. One of the latter is shown in Fig. 2. These were used for both 4 in. and 6 in. partitions, and are still the standard article of manufacture by some makers. But they make the partitions unnecessarily heavy, and are more expensive to set than larger and lighter blocks. The tiles for partitions made by Johnson were 10 by 10 ins. without any cross webs, and ¾ in. thick. In 1881 partition tiles were used at Chicago which were 12 by 12 ins., with one and two cross webs. They were only ½ in. thick and made of hard fire-clay. An illustration of these is given (Fig. 3). They were generally laid on the side, though, being square, they could be set on end, like the Johnson tile, which was frequently done, especially where the partition was very high or subjected to great weight, as in the surrounding of an elevator shaft. At angles they were always set on end. Greater care and a little more expense is required in setting partition tiles on the ends. This method is also the best when the partition is not to be plastered, as when they are set on the side it is impossible to fill all the vertical joints. This remark does not apply, however, to the 4 by 6 blocks, which are laid like large bricks, and have more surface at the ends to hold the mortar joint. They, however, show the holes at the angles of partitions which have to be filled with mortar. Hollow partition tiles may now be had for partitions 2, 3, 4, 5, 6, and 8 ins. thick, and 12 in. partitions may be had by setting 6 by 12 in. tiles on the flat side. This is a handy way to build light fire-proof vaults in buildings where there are sufficient foundations.

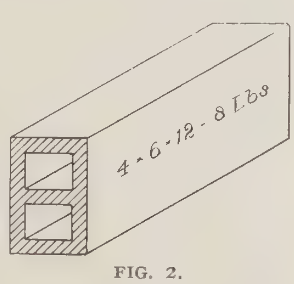


FIG. 2.

The thickness of partitions in practise is regulated by the heights of stories. A 3 in. partition can be safely built to 12 ft., a 4 in. to 16 ft., and a 6 in. to 20 ft. in height. I advise that these be the outside limits, as there is a possibility of careless workmanship that has escaped detection. I was once required by an architect to build the 3 in. partitions in a story 16 ft. high, he taking the responsibility. They were tested by severe shaking before the doors were put in or any plastering was done, and though very elastic we could not pull any of them down by hand, and they are there to-day. The length of any one straight section of a partition is a more important element than its height, and judgment must be used in every case. I have built a 3 in. partition around two sides of an elevator shaft, 120 ft. high on girders in the cellar, the tiles being set on end; the weight at the bottom course was about 1,500 lbs. per lineal foot. This was only 94 lbs. per square inch of tile area.

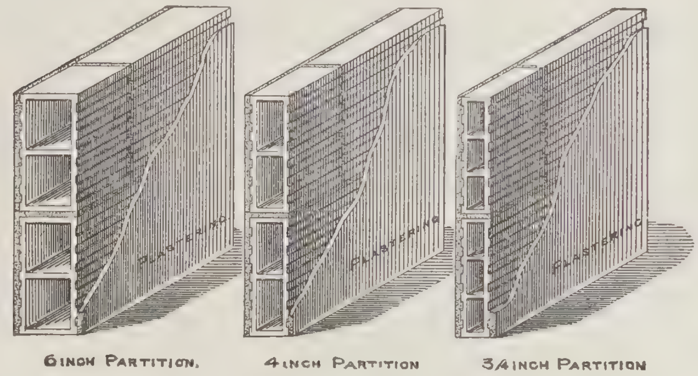


FIG. 3.

It is customary in St. Paul and Minneapolis to build the partitions in office buildings, having stories 10½ ft. in the clear, with 2 in. porous tiles. The tiles are 8 by 12 ins. and abundantly strong when set in good mortar tempered with cement. When they want to cut out additional doors between rooms the carpenter does it with a saw. Two-inch partitions of hard hollow tiles have been recently built in Chicago. The same tiles are also used for wall furrings, and building out architectural shapes around columns, and boxing in pipes.

When book tiles were first used for roofs it was found that the same die would make a square partition tile which was very useful under certain circumstances. It was possible to give greater strength to long partitions without lateral supports by setting them on the side. The tiles, breaking joints, could be built up to a great length even without mortar. This led to making 4 in. book tiles for partitions. These have been used considerably in the Central States, but not at the East. An illustration is here given (Fig. 4). Another use was made of tiles of this section; wood blocks 1 in. thick were mill-worked to fit exactly between the joints of these tiles, and cut off to the length of the tiles. They were used only between tiles set in courses on end, wherever nailing was required. Thus, wherever there was to be wooden wainscoting, the first and fourth courses were set on end with wood blocks between which were as immovable as the tiles. These blocks should never be used in the joints when the tiles are set horizontally.

Two questions of importance are to be considered in setting partitions: the first is securing them to the walls and ceilings, and the second is the treatment of openings. The simplest and best way to secure partitions to brick walls is to drive large cut nails (not wire nails) into the joints of the brickwork on top of each course of tiles before setting the next course. The heads of the nails will then come between the courses. Cut nails are better in mortar or in porous tiles because they are of wedge shape. Nothing more than a few wooden wedges at the top is of any use. It is best to set partitions in the lower stories first and work upward. The weight of the partitions on each floor

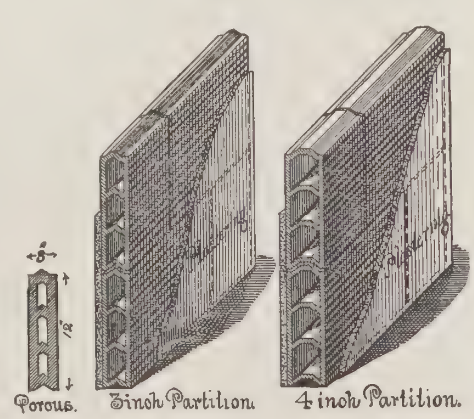


FIG. 4.

will add to the deflection of the beams of that floor, and thus bring pressure on the partitions of the floor beneath; while, if the partitions on the upper floor are set first, the setting of the partitions of the floor beneath it will pull them away from the ceiling. In buildings with wooden joists no dependence can be had on securing tile partitions at the top. They will always settle down and show a crack at the ceiling line unless they are set on steel beams. It is best for fire-proofing purposes in every case to set partitions after the ceilings are brown coated.

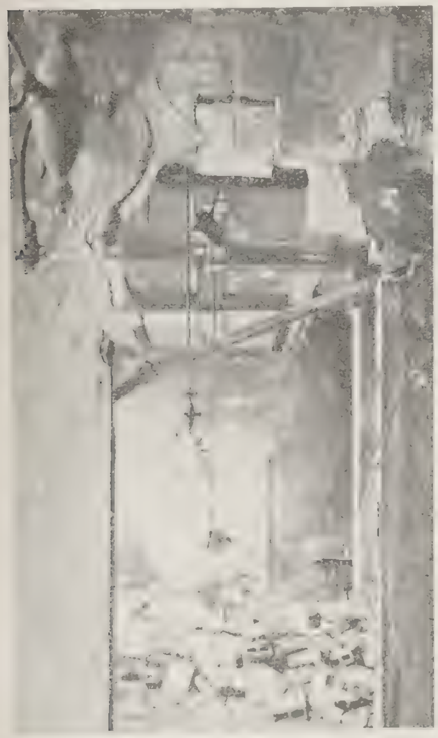


FIG. 5.

The greatest faults to be found in hollow-tile partitions are in the methods used for building doors and windows in them. First of all, the top of a door should always be covered with a flat end-pressure arch made of the partition material. As an example of how not to do this, see the half-tone from a photograph of a partition door in the Horne Office Building at Pittsburgh, taken after the fire in that building (Fig. 5). Here the tiles over the door have fallen down, while a natural arch has been formed by those that held their places. Where there are long rows of windows it is impossible to put in an arch. In such cases no expedient can be relied upon except to build a channel bar frame in each opening. It has been shown in repeated fires that all rough wooden frames are useless. If there must be finished wooden jambs, they should be screwed to steel jambs, but it would be better to hang all doors to steel jambs made of channels. The tiles can be built into them and their flanges will become grounds for the plasterer. An ornamental German steel rolled molding can be used to cover the joint. Where there are only occasional doors in the partitions and economy is desired, the rough wooden jambs can be secured in no better way than the simple one of driving two cut nails into their backs between the joints in the courses of tiles, and depending on the weight of the tiles on the projecting nail heads to hold the rough frames in place. These are better than angle cleats or anything else of the kind. No door studs should run to the ceiling. The tile partitions will always stand the racket if the door jambs are secured firmly to them. Experience has shown that no dependence can be placed in nails for securing anything to porous tiles, but wood screws are reliable.

Furring brick walls is a simple process that requires little comment. The best method is that shown in the illustration (Fig. 6). This shows porous terra-cotta plates 2 ins. thick and 12 ins. square.

(Continued.)

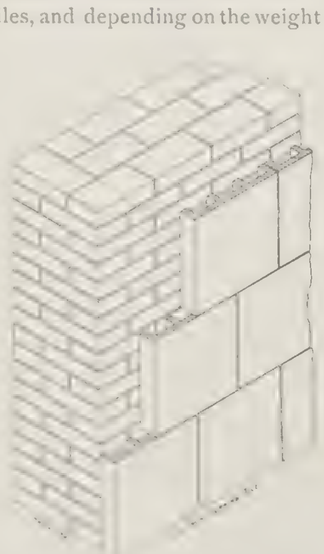


FIG. 6.

Mortar and Concrete.

LIME, HYDRAULIC CEMENT, MORTAR, AND CONCRETE. VI.

BY CLIFFORD RICHARDSON.

THE ROSENDALE CEMENT INDUSTRY.

A GREAT anticlinal fold, extending along the valley of Roundout Creek from the Hudson River to the south and west for many miles, brings to the surface a series of cement rocks which is the source of the raw material for the great Rosendale cement industry; an industry which, as has been shown, supplies the Atlantic Coast with over three million barrels of cement a year, and which includes the mills of one company, alone able to turn out seven thousand barrels of cement a day.

The rock of suitable nature for cement making consists of two beds, one lighter in color than the other, which are separated by from 6 to 12 ft. of rock, not sufficiently argillaceous for making cement. The average thickness of the light rock is 11 ft., and the dark rock 21 ft. They are now quarried at a considerable depth below the surface, and obtained in a dense and unaltered condition. A collection of the rock from quarries, working at three different depths, made especially for the purpose in May, 1897, had the following composition: —

UPPER OR LIGHT STRATUM.

Density.	Nearest Surface.		Medium Depth.		Deepest.	
Coarser than 200 sieve	2.9		0.		.6	
Coarser than 100 sieve	2.3				.6	
Coarser than 50 sieve	1.7				.4	
Loss on ignition	38 00		36.90		37.72	
Insoluble in HCl	17.38		22.68		20.68	
Total Alumina and Iron Oxides	5.50		7 62		7.20	
Total Carbonates	80.50		72.70		75.80	
Carbonic Acid, Water, etc.	38.00		36.90		37.72	
Lime CaO, soluble	26.66		23.60		23.92	
Lime CaO, insoluble	trace		trace		trace	
Magnesia, soluble	15.00		13.70		15.06	
Magnesia, insoluble	.79		.88		.69	
Total		15.79		14.58		15.75
Alumina, soluble	1.04		1.88		.56	
Alumina, insoluble	2 94		3.80		3.52	
Total		3.98		5.68		4.08
Iron Oxide, soluble	1.52		1.20		1.96	
Iron Oxide, insoluble	40		.74		1.16	
Total		1.92		1.94		3.12
Silica	12.72		16.66		15.14	
Sulphuric Acid	.68		.13		.09	

LOWER OR DARK STRATUM.

Density.	Nearest Surface.		Medium Depth.		Deepest.	
Coarser than 200 sieve	0.		0.		1.2	
Coarser than 100 sieve					.5	
Coarser than 50 sieve					.3	
Loss on ignition	33.84		36.28		34.60	
Insoluble in HCl	16.62		22.90		25.06	
Total Alumina and Iron Oxide	8.14		11.00		7.78	
Total Carbonates	70.20		66.50		73 30	
Carbonic Acid, Water, etc.	33.84		36.28		34.60	
Lime CaO, soluble	22.00		22.17		22.01	
Lime CaO, insoluble	trace		trace		trace	
Magnesia, soluble	13 90		12.07		13.15	
Magnesia, insoluble	.83		.79		2.98	
Total		14.73		12.86		16.13
Alumina, soluble	1.12		3.92		2.58	
Alumina, insoluble	3.68		4.38		2.26	
Total		4.80		8.30		4.84
Iron Oxide, soluble	3.34		2.70		1.72	
Iron Oxide, insoluble	.92		.86		1.22	
Total		4.26		3.56		2.94
Silica	18.40		16.22		18.48	
Sulphuric Acid	.17		.25		trace	

The hydraulic limestones of the Rosendale cement formation are seen to be somewhat variable in different localities and at different depths of the quarries from the surface. The upper or lighter stratum or bed is richer in carbonates than the lower or darker one, and, of course, poorer in silicates and oxides of iron and alumina. The nearer to the surface the quarrying is done the greater the amount of carbonates in the lighter stone, and the smaller the amount of silicates. This surface stone seems to be the most inferior in use. It is, however, mixed with the rock from the deeper quarries, having the most silicates, so that a proper average composition is obtained. All the cement rock contains much magnesia, from 15.06 to 12.07 per cent., but, fortunately, the silica and alumina are not, as a whole, deficient in amount, so that none of the strata are rejected. They

require careful combination and proper burning, however, and their composition being so variable should be frequently determined by analysis, as a control. The best cement produced from this rock may be regarded as the highest standard of what a natural cement should be.

BURNING OF NATURAL CEMENT.

Natural cement is burned in much the same way as lime. The kiln commonly used is the ordinary draw kiln, a structure of masonry lined with fire-brick, or an outer iron casing, or shell, enclosing a light brickwork the space between which and the fire-brick lining is filled in with sand or loam. These kilns are from 20 to 30 ft. high and from 8 to 12 ft. in diameter. They are arranged either singly, in pairs, or in banks, and have somewhat varied vertical sections. There is generally an increase in diameter from the top to a certain distance, and then a more or less gradual contraction to the throat, an opening at the bottom, or eye, through which the draught of the kiln is maintained and the burnt stone drawn.

The peculiar forms seen in practise are characteristic of the localities where they are used.

In some works flame kilns have been employed in which the combustion is carried on in furnaces outside of the main body, and the stone burned by the heat of the products of combustion. These kilns have no great application in the United States, as they require more fuel and more constant attention. Theoretically they are a much better form, as the finished cement is not mixed with the fuel ash, and the burning is more regular. The cement produced by them is found, however, not to be so much more satisfactory as to repay the extra cost.

Ordinary kilns hold enough stone to make from 300 to 600 barrels of cement of 300 lbs. each. They are charged with alternate layers of stone of suitable size, and coal. The size of the rock depends upon the ease with which it can be calcined, and the degree required for producing a good cement. It is at times uniform, or a certain proportion of finer material may also be added to prevent the too free burning of the kiln.

The proportions of fuel and stone vary very much. From one quarter to one eighth of the weight of the stone in coal is used.

The regulation of the temperature and time of burning is accomplished by varying the amount of coal, the size of the pieces of rock, the draught through the kiln, and the length of time between each drawing. The amount of coal and the draught are, of course, the principal factors in the burning. For hard burning more coal is used, for quick burning less, and more draught.

In burning the Rosendale cements there has been no change in the form of kiln since the early days of the industry. The old-fashioned draw or pot kiln is still in use, the eyes of two kilns opening into the same drawing pit, and the kilns being arranged in banks of six or more. The fuel is fine anthracite which is charged alternately with the rock, about 4 ins. of the former and 18 to 20 of the stone, which corresponds to about four and five tenths to five times more stone than coal in volume. Gilmore states that at the Ulster County cement works 3,500 lbs. of coal burns 30,000 lbs. of cement, which would be equivalent to over 40,000 lbs. of rock, and a proportion of over twelve times as much stone by weight as rock.

The kilns are drawn twice daily in the Rosendale district, beginning at 5 A. M., continuing until the rock gets hot, and again in the afternoon. At night the kilns are heaped up, and are burned down by morning. From 1 cu. yd. of rock nine barrels of cement are ground.

In the Potomac Valley and in the West bituminous coal is used in the same way. The custom there is to draw but twice a day, with the limestones free from magnesia, while at Fort Scott, Kan., small drawings are made every four hours. For each stone and each kind of fuel and form of the kiln the best proportions must be learned by experience, and it is not always possible to learn them from the manufacturers.

If the kilns are not properly charged and watched they may burn too quickly and freely, or, not having sufficient draught, the stone will be burned too little or unevenly, and the quality of the cement be inferior. Some rock, under careless regard of conditions, will be over and some underburned.

Finally, there is such a difference in the way various hydraulic limestones ought to be calcined that they should each properly be burned in separate kilns, where strata of different composition in the same quarry are in use, and the product then mixed in the most desirable proportions. Economy and carelessness, however, seldom permit of this refinement in practise.

TEMPERATURE OF BURNING.

What the suitable temperature and length of time of burning any particular stone may be depends on its composition as well as on its physical properties, density, and state of aggregation.

With a good stone, with medium percentages of clay, of fine grain and good density, a gentle and rather prolonged burning is best. The carbonic acid should be nearly, but certainly not entirely, removed from its combination as carbonates, yet no signs of sintering or clinker should appear.

When the insoluble part is more silicious than clayey, and especially when it is rather coarse, a very gentle and prolonged heat is the best to enable the lime to slowly combine with the silica.

When the insoluble matter is clay, and this is present at all in excess, a sharp, quick heat is found most desirable. The higher the amount of insoluble matter or silicates in a hydraulic limestone the more carefully it must be burned and the lower the heat must be. Rocks of this class, when overburned, are liable to crack and blow on setting.

When magnesia is present in large amount the rock can be burned in two ways, either below a red heat sufficiently to expel the carbonic acid from the magnesian carbonate, and to a smaller degree from the calcium carbonate, which gives a cement of considerable hydraulic activity; or it may be very strongly burned until the hydraulic activity of the magnesia is destroyed. The latter method is seldom or never followed in practise, as it is difficult to regulate and not universally applicable.

The smaller the amount of clay and silica in magnesian rocks the more moderate must the burning be, until finally a dolomite with no clay is reached, which, with light burning, will yield a mixture of magnesian oxide and carbonate of lime which has very considerable hydraulic activity.

Magnesian cements deficient in clay, which approach hydraulic limes, if not burned carefully, are, however, very apt to expand a long time after use.

In the Rosendale limestones of Ulster County, New York, a suitable amount of clay is found, and this, together with the density of the rock, gives the cements made from them their desirable properties, as distinguished from the Western New York cements, which are, most of them, scarcely more than hydraulic limes.

CHEMISTRY OF BURNING.

In the process of burning cement stone the rock, at a low temperature, is dried out. At about 750 degs. Fahr. it begins to lose carbonic acid, although a continued bright-red heat is necessary for the complete conversion of the carbonates to caustic lime and magnesia. A porous stone burns much more easily than a very dense one. The best hydraulic limestone requires, therefore, longer burning than the inferior material. The rate of burning also depends on the size of the fragments and upon the rapid removal of the carbonic acid from the kiln, as in ordinary lime burning. The amount of clay or silica in the stone has also an influence; the more of these substances present, the more difficult the burning.

When the carbonic acid has been driven off in part the free lime, at the high temperature, attacks the clay and silica, combining with them to form new compounds having hydraulic energy and rendering them soluble in acid, although previously insoluble. The heat, however, in the process of natural cement making is not great

enough to bring about the combination of the entire amount of lime present with the silica and clay, as in the case of Portland cement. A certain amount remains uncombined, both free and as carbonates, and the silicates and aluminates are not as basic, lime and magnesia not being present in these compounds to their full capacity, as they are in the artificial cements, where as much lime is combined with the silica and alumina as is possible, to form very basic compounds.

Some free lime, and generally carbonates, are therefore present in natural cement, and are characteristic of it.

If too great a heat is used in burning, approaching that employed in the Portland cement manufacture, compounds are in most instances formed which have no hydraulic value unless the proportions of the various constituents in the stone are approximately those required for that class of highly burned artificial cements known as Portlands, when such a substance may be formed. In the presence of too much clay overburned natural cements contain very unstable compounds which, while they may at first set on addition of water, check later and fly to pieces.

When there is an excess of certain elements in limestone, such as alkalies or sulphates, these substances may enter into the reactions of the burning process and complicate it, as they have a tendency to form with ease compounds of ready fusibility. Rocks of such composition are unsuitable for use.

ILLUSTRATIONS OF RESULTS OF BURNING.

The peculiarities which have been mentioned may be illustrated by some particular cases.

No. 1. A Lime Cement. This cement when freshly made had the following composition :—

Loss on ignition, carbonic acid, and water,	10.27
Silica and silicates, not decomposed by burning,	9.80
Silica combined with lime in burning,	20.42
Alumina and iron oxide,	13.76
Lime,	39.54
Magnesia,	3.80

This cement, burned from a stone comparatively free from magnesia, as ready for use, loses only about 10 per cent. of its weight on ignition, consisting of water, with which the freshly burned stone was sprinkled to lengthen the time of setting, and of carbonic acid, which shows that the burning was thorough. The silicates have not, at the temperature employed, all been decomposed and become combined with lime, but very much the largest part has done so. There is an ample amount of alumina, all of which has been converted into compounds of hydraulic value in the kiln. This cement is an excellent example of this type of natural lime cements.

Tests for tensile strength gave the following results :—

Neat at	1 day	150
	7 days	440
	28 „	452
2 parts quartz	7 „	244
	28 „	276

It acquires strength rapidly in the test pieces in seven days, and would be found to increase slowly for one or two years thereafter. In actual use, with larger quantities of water in the mortar, it would of course attain its strength more slowly.

No. 2. A Blowing Magnesian Cement. This cement, when made into briquettes and immersed in water, checked and blew to pieces in a few days. The difficulty is revealed by the following results of an analysis :—

Loss on ignition, carbonic acid,	7.44
Silica and silicates, undecomposed,	17.09
Silica combined,	10.88
Alumina and iron oxide,	13.26
Lime,	38.69
Magnesia,	9.64
Sulphuric oxide,	.95

The burning, it appears, has been so conducted that, while carbonic acid had been largely driven off, the temperature was too low to permit of combination of the free lime with the silica, although unstable alumina compounds had been formed. The cement, therefore, blows. On reburning it, at a higher temperature, for a short time a normal magnesian cement was obtained. It contained then but 3.70 per cent. of carbonic acid, and but 4.70 per cent. of undecomposed silicates. This cement gained strength slowly but regularly, and, when properly burned, has been largely used in concrete with great success.

Tensile strength tests resulted as follows :—

Neat at	1 day	82
	7 days	102
	28 „	252
	3 months	340
	6 „	358
2 parts quartz	7 days	59
	28 „	120
	3 months	238
	6 „	288

No. 3. A Magnesian Cement Deficient in Clay. This cement gave very low results on testing for tensile strength for the first few days after mixing, but soon gained rapidly, expanding, however, very considerably at a greater age. Its composition was as follows :—

Loss on ignition,	6.00
Silica and silicates undecomposed,	4.48
Silica combined,	13.06
Alumina and iron oxide,	5.01
Lime,	41.79
Magnesia,	29.60

The cement is plainly deficient in silica and alumina and contains a very large amount of magnesia. It has been burned, apparently, quite hard, and is practically merely a dolomite cement which is weak at first, and afterwards, although attaining very considerable strength, expands. To obtain the best results with this cement it was, of course, necessary to burn it quite hard. The results of tests for tensile strength were as follows :—

Neat at	1 day	36
	7 days	230
	28 „	400
	6 months	Expands
2 parts quartz	7 days	130
	28 „	300
	6 months	Expands

This cement is used successfully for much work where the expansion in sand mortar does no damage, but it is hardly satisfactory to use such material.

HARDENING AND DETERIORATION OF LIME MORTAR.

BY H. K. LANDIS, E. M.

IT frequently happens that specifications are very rigorous in their requirements for the character of sand employed in mortars containing the best grade of lime, and very exacting in the proportion of sand to be used. This is probably due to the antiquated idea, held by some, that the sand actually combines with the lime and forms large proportions of silicate of lime. It is a fact that silicate of lime is formed in lime mortars, but not in quantities sufficient to make it the predominant factor in hardening of mortar. Petzholdt found two thirds of 1 per cent. of the quartz sand added to lime had combined with it in five weeks, while but one tenth that amount was found combined at the end of one week. In a wall one century old 2.1 per cent. of combined silica was found, while this was increased to 6.2 per cent. in a mortar three hundred years old, although the original lime contained but 0.11 per cent. combined silica. The

hardening effect of this silicate of lime is, however, insignificant when compared with the total hardening of lime mortar, for after several years there will be but half a per cent. of silicate of lime in the mortar.

This silicate is not very stable because carbonic acid, a comparatively weak agent, displaces it. Moisture favors the formation of silicate of lime, so that its formation begins from the time the mortar is mixed, and is comparatively rapid until the lime mortar has dried; then carbonic acid gas begins to act, and as numerous observations and analyses have shown, really displaces the silicate with carbonate, for scarcely a trace of silicate is found among the carbonate; it, however, exists in the interior where the gas has not yet penetrated.

The mixture of sand with lime is thus not the necessary condition of hardening, for hard mortars can be obtained by mixing finely ground limestone or chalk with the lime. Its functions lie more particularly in making the mortar more porous, thus permitting easy access of carbonic acid gas in counteracting the effects of shrinkage, and in reducing the cost of mortar.

Sand should be free from earth, dust, clay, or iron rust in order to permit the close adhesion of lime to it; this action is mechanical. It should be angular, as the mortar is thus not so liable to fracture along a smooth plane, which is thus one of greater weakness; angular masses knit together and bind each other, and are also more elastic; the sharp edges of the silica sand do not form silicates to any noteworthy extent. The particles should be uniform in size and not too coarse, in order to avoid the occurrence of flat surfaces in the section of mortar which would be large enough to weaken the mortar itself, because the cohesion of lime for itself is greater than its adhesion to any large surface. Thus far a specification can reasonably go.

Not all mortars are equal setting; some become solid in a few days, while others will not be completely hardened in a century. When fresh mortar is exposed to the air it first loses part of its water, then begins to take up carbonic acid gas, which is given out by animals, and by vegetable combustion, and has its hydrate of lime changed to carbonate of lime. This absorption takes place gradually, from the surface inward, and usually does not begin until the mortar has set; it is found that the proportion of water in fresh mortar — about 50 per cent.— is strong enough to prevent the formation of carbonate of lime, and to prevent the absorption of gas. If we place fresh mortar in a glass tube and fill it with carbonic acid gas, the mortar will be unchanged after many days, and the quantity of gas absorbed will be insignificant, while the same mortar exposed an equal time in air will have absorbed considerable gas.

Suspend in a flask filled with carbonic acid gas samples of fresh mortar. At the end of a week it will be as moist as when put in, and will have absorbed less than 1 per cent. of its weight of gas. If, now, a dryer, such as strong sulphuric acid, is placed in the bottom of the flask, the same samples of mortar will absorb the carbonic acid gas in the flask at the rate of about 14 per cent. per day. A number of other experiments may be performed to show the same fact. If, however, we dry the mortar completely we obtain a very compact but very friable mass. Duquesnay says that in this state the mortar does not harden and absorbs no carbonic acid gas. A certain amount of moisture is thus necessary in the mortar.

The formation of carbonate of lime is favored by drying slowly after setting, and this also favors the cohesion of the hydrate, since the particles which solidify first are surrounded by a solution of lime which on drying leaves its lime on the outside of these particles and cements them together just as the grains of sand are cemented together in the formation of sandstone; this cementing is the more complete as the drying is slower, and thus one can explain the extreme solidity of masonry of the middle ages, which now must be blasted in removing.

Gas penetrates smooth surfaces more slowly than rough ones; in fact, the character of the surface exposed to the air has a very strong influence. In a block of lime which was examined chemically at the end of a year, the depth to which carbonation had penetrated on a trowel-finished side, a rough-finished side, and a side which had been broken off, was in the proportion, respectively, of 3 to 7 to 14, half the surface of a cross section being unaffected. This would indicate that the usual method of smooth finishing joints is not the best.

Deterioration in mortars has numerous causes which depend upon both outside conditions and the character of the mortar itself. It is assumed that stone and sand shall be used, which will be unaffected by the ordinary agencies with which it comes in contact. Precautions are easy to observe in this regard, but when we come to lime it is not so easy to prevent alteration. Lime is soluble in water, and if exposed to a current will be taken up by the water quite rapidly. When the mortar has somewhat hardened in air and is then exposed to still water the effect is inappreciable, for the lime is protected by a superficial coat of carbonate, and not only resists the dissolving action of the water but attains to considerable hardness.

Nitrogenous matter, such as manure or urine, can produce nitrates of lime under certain conditions of moisture and temperature. This salt deposits as snow-white accretions on the stone or as a superficial layer on the mortar, and sometimes resemble flakes of snow. Such salts are used in the chemical industry; their production should be discouraged, as they have a deteriorating effect on the masonry, making it liable to crumble.

Efflorescences of another kind often appear on the surface of the walls, such as sulphate of soda, carbonate of soda, chloride of sodium, carbonate of potash, and chloride of potassium, which contain the constituents of neither stone, brick, nor sand, and are hence attributed to the kind of lime used in the mortar. The presence of alkalies is explained by their existing in the original limestone before calcination, or that they are derived from wood and coal ashes which contain considerable quantities of alkalies; sometimes soil alkalies are brought in by surface waters and disperse through the walls, leaving a white deposit on the surface when they evaporate.

Ammoniacal fumes are given out by many industrial operations, as when tobacco waste is burned in fireplaces along with coal or coke; the latter furnish sulphurous vapors derived from the oxidation of iron pyrites in the coal, which combines at the top of the chimney with condensed water vapor and ammonia gases, forming sulphate of ammonia; this liquid in a short time causes the mortar to disappear entirely. The use of salty water for slaking lime or mixing mortar causes the formation of chloride of sodium and carbonate of soda (common salt and washing soda), which absorb moisture readily and tend to constantly keep the walls damp.

THE ELECTRIC CONDUCTIVITY OF CEMENTS AND BETONS.

IN a very interesting series of experiments made by Dr. Lindecka and described in the *Electrotechnische Zechschrift* a considerable amount of new information was brought to light.

He found that the electric resistance of a cubic foot of cement, when dry, was about 144 ohms, which fell to 43 ohms after 24 hours' immersion in water, while it rose to 820 ohms when exposed to a temperature of 212° Fahr.

Sand and gravel increase the electrical resistance one part of cement to seven of gravel in a block having a resistance of 18,000 ohms, which fell to 72 ohms when the blocks were wet, or rose to 2 megohms at 212° Fahr.

If we allow for concrete an average resistance of 1,670 ohms per cubic foot, one obtains an insulation resistance of about 1.2 ohms per thousand. In asphalt paving the loss of current through the asphalt is very small, so that where conductors are laid directly in the concrete they should be surrounded with asphalt cement. This cement is usually made, one half broken stone; gravel, free from clay or sand, 20 per cent.; asphalt, 12 per cent.; tar, 8, and mineral oil, 10 per cent. These figures are important, not only as showing how current may be saved, but also in pointing out the conditions under which cement insulation may become a dangerously good conductor.

The Masons' Department.

HOW SHALL THE VALUE OF EXTRA WORK BE DETERMINED?

THE most irritating and troublesome questions which the architect and contractor are called upon to consider are probably those of determining the value of extra work or work omitted. The zeal which the architect often displays in the interest of his client on the one hand, and on the other the pernicious habit of many contractors who take work at cost or below and depend on changes to make their profit, are perhaps equally responsible for the trouble which ensues. It takes comparatively little experience to absolutely prove that almost no building contract is carried to completion without more or less changes from the original scheme. And the alterations made from time to time, which affect the progress of the work, must of necessity be ordered without delay and in accordance with the terms of the contract. The natural result of this is that very little time is afforded the architect to verify the propositions of the contractor, and the necessary haste often tends to encourage arbitrary action. While most all building contracts at the present time provide for an appeal from the decision of the architect by either of the parties concerned, and the reference of such questions to three arbitrators, such a course is rarely taken. The complexity of the architect's duties makes it impossible for him to keep more than generally informed as to the value of the various work and materials which enter into the construction of a building, and he must, therefore, adopt one of two courses to obtain the information which is necessary for him to possess in order to fulfil his obligation to the client on one side and the builder on the other; the first is to arrive at a conclusion from personal observation and experience; the other is to obtain the desired knowledge from experts, that is to say, those who are engaged in the same sort of business in regard to which the question arises. Each of these courses have their own peculiar disadvantages. In the first instance, the architect is usually inclined to undervalue, for the simple reason that it is almost impossible for an outsider to appreciate the amount of detail which goes to make up the cost of labor and materials connected with any given piece of work. If, on the contrary, he seeks expert advice, what may be broadly defined as "professional courtesy" prevents his getting at the bottom facts, or else, for some reason, the person to whom the matter is referred takes the opportunity to even things up or pay off an old score by giving prices unreasonably low. The simple truth is that the position of the architect, when called upon to determine what is a fair value for the work of a contractor, is one which is extremely difficult to fill with any degree of satisfaction to both of the parties concerned. This fact has led some architects to insert a clause in their contracts making the architect the sole judge of the value of work and materials, with no appeal from his decision. This arbitrary method can hardly be defended as quite just or reasonable, but one is sometimes inclined to believe that even a solution as absolute as this is preferable to the discussions and irritations of a less severe method; for under this plan the matters can at least be settled promptly and once for all, which in some ways has an advantage over the usual manner which so often involves perhaps a greater loss in the way of delays than would be suffered by the arbitrary decision of the architect. There can be no question that, if some method could be devised by which the value of extras could be settled both promptly and fairly, the builders who figure to do work exactly as called for, and include in their original estimate a fair and reasonable profit, would be much more likely to be successful when in competition with those who pursue the opposite course. There are very few architects of standing who would not prefer to give their work to the former class, but the apparent saving by the acceptance of a low bid is usually too much of a temptation to the client, who cannot be made to realize the economy of a just discrimination until he has paid out much more than the original saving in overvalued extras and undervalued omissions.

The satisfactory solution of this problem seems at first thought a difficult matter, but in reality it probably presents no more serious complications than many other questions which have been met and settled. With the knowledge which both architects and contractors have on this subject, it is to be hoped that their organizations will realize the importance of instituting a reform in this direction.

CONTRACTOR.

EDITOR OF THE BRICKBUILDER.

Dear Sir: — May I trespass on your valuable space to ask for a bit of advice? I am erecting a building of which the first story is stone, and the upper stories of brick and terra-cotta. For constructive reasons the masonry should be laid up in cement, but I do not dare to risk the staining which cement is so apt to impart to the stonework. I have been advised to put a certain amount of sugar in lime mortar and use the mixture instead of cement, and I have been told that the addition of sugar to lime mortar will produce a species of cement which will set up very nearly as hard as if hydraulic cement were used. Is this true? Can you give me any idea as to the proportion of sugar to use? And whether there is any liability of the mortar staining the limestone? I was advised by the mason to cover the back of the stonework with asphalt, but I hesitate to do so, fearing that the oil in the asphalt would work through and stain the stone. Is there anything else which can be used to advantage to prevent the moisture of the cement from the brick backing working out through the stone?

Also, in regard to the terra-cotta, it is to be what is commonly designated as white terra-cotta. In the last building upon which I used this shade of terra-cotta I find that the surface of the material is stained somewhat, and though the building has been finished for over a year, the individual blocks are not of the same tone, and none of them have come back to the color they presented before the work was set in the building. The terra-cotta was laid up with mortar composed of lime, with a very small proportion, I think one sixth in bulk, of Rosendale cement. I am afraid to use cement in the new work. Why should the light terra-cotta stain, or, why should it not regain its original color when dried? I feel that facts of this sort are pretty vitally connected with the use of terra-cotta, and should be glad of any advice you could give me.

ARCHITECT.

IN regard to the staining of stonework, Lefarge cement, it is claimed, will not stain the stone at all, but any other cement which is on the market at present, with which we are familiar, is liable to produce discolorations. The value of sugar as a component of lime mortar is an unknown quantity to us. It has been used repeatedly, but we are unable to give any exact information as to the quantity necessary to produce the best results. The value of sugar as a component of lime mortar lies in the fact that sugar unites with a portion of the lime, forming saccharate of lime, which is considerably more soluble than the ordinary hydrate. Consequently, the resulting mixture will form a more intimate bond with the sand.

In regard to the staining of terra-cotta, it may come from one of several causes. We do not believe that cement can be trusted in any quantity in the mortar which is to be used for setting up light-colored terra-cotta. Even one sixth might produce permanent stains. Another cause of possible stains is due to the terra-cotta being improperly packed in soiled material. We know of one case where straw was used which had been taken from a stable where it had served as bedding for horses, and the owner of the building in question was for a long while at a loss to account for the vile yellowish stains which appeared on his terra-cotta. We believe, however, if pure lime mortar, the lime for which has been slacked at least three weeks before being used, is employed with clean, sharp white sand, and proper care is taken in the handling and setting, and nothing but pure water is used to clean off the surface of the terra-cotta, there will be no stains whatever on even the most delicate shades.

The use of iron ties is not advisable in connection with terra-cotta if extreme precautions are to be taken. Nothing better has so far been found than copper for this purpose, and if iron is used, even when thoroughly galvanized, it is liable to rust; and a very slight amount of oxide of iron is capable of producing serious stains in the terra-cotta.

It must be remembered that it is not enough to lay up the terra-cotta itself with mortar from which the cement is excluded, but the brick backing must equally be kept free from the disturbing influence, for it has been found that the staining qualities of the cement will penetrate through several courses of brick and affect the exterior surface of the terra-cotta. Furthermore, it is bad construction to lay up the backing of a wall with a different mortar than the front. The matrix ought to be the same in each case to insure equal shrinkage of the joints and to preserve the alignment of the wall.

We refer the questions of our correspondent to our readers, and would be glad to receive any information on the subject. EDS.

QUANTITY OF MORTAR REQUIRED FOR A THOUSAND BRICK.

A WRITER discussing in one of our exchanges the quantity of mortar necessary to lay 1,000 brick, states that this is a point on which knowledge is essential before one can properly estimate the cost of brickwork. He says that the proportion will vary with the size of the brick and with the thickness of the joints. With the standard size of brick, which are $8\frac{1}{4}$ by 4 by $2\frac{1}{4}$ ins., a cubic yard of masonry laid with $\frac{1}{2}$ to $\frac{5}{8}$ in. joints will require from .35 to .40 cu. yd. of mortar; or 1,000 bricks will require .80 to .90 cu. yd. If the joints are $\frac{1}{4}$ to $\frac{3}{8}$ in. thick, a cubic yard of brickwork will require from .25 to .30 cu. yd. of mortar; or 1,000 bricks will require from .45 to .55 cu. yd. If the joints are $\frac{1}{8}$ in., as for pressed brickwork, 1,000 bricks will require from .15 to .20 cu. yd. of mortar. It should not be difficult for an estimator to be able to tell exactly the cost of the matertals required to build up 1,000 bricks in a wall, having the cost of bricks, sand, and lime at hand, including hauling, with the above data before him. It is a little difficult to tell exactly how many bricks a man will lay in a day of nine hours, as conditions vary, and some men are much more expert than others; but if well supplied with materials, and no scaffolds to adjust, and a long wall to work on, 1,500 bricks would make a good average day's work. If, however, there are many openings to work around, and neat facing to do, from 900 to 1,100 will make a good day's work. In good ordinary street fronts from 700 to 900 may be counted, and in the finest street work, where there are numerous angles, doorways, or belting courses, from 150 to 250 may be considered a good day's work. In large works, or where walls are very thick, a good man will lay from 1,500 to 1,800 bricks, but this is rather the exception than the rule. A good laboring man will mix mortar and carry it and bricks for the bricklayers, if mortar and bricks are not more than 25 ft. from the building, and provided he does not have to carry water or climb a ladder. As the brickwork of a building rises, so does the cost. Whatever may be the figures obtained as the cost per 1,000 of laying bricks for the first story, 5 per cent. should be added to it for laying the bricks for the second story, and $12\frac{1}{2}$ per cent. for the third story, and a corresponding percentage for the work laid in higher stories.

SURETY ON BOND OF CONTRACTOR.

WHERE a building contract provides as a condition precedent to the final payment that there shall be no legal claims against the contractor for work or materials furnished, a surety on the bond of the contractor cannot enforce a lien for work or materials. He cannot be permitted to recover without violating his contract of suretyship, and he must therefore be held to have waived the right to file any lien in the face of his contract. — *Supreme Court of Pennsylvania.*

Recent Brick and Terra-Cotta Work in American Cities, and Manufacturers' Department.

CHICAGO. — Foundation walls are being constructed for a church which promises to be a very interesting piece of brick architecture. The designs of the architect, Mr. H. J. Schlacks, show the extreme dimensions of the building in plan to be about 108 by 203 ft. The style is denominated by the architect "late Romanesque Gothic." The plan is a modification of the general Gothic type of the middle ages. The nave is 40 ft. wide between piers, while the aisles are narrow, and having no seats, serve for aisles only.

The foundation walls are of rubble stone and rest directly on natural rock 15 ft. below grade, the same stratum which is more than

TERRA-COTTA PANEL, MISSION LODGE HALL, SAN FRANCISCO, CAL.
Hermann & Swain, Architects.
Executed by Gladding, McBean & Co., San Francisco, Cal.

100 ft. under sand and clay at the business center of Chicago, five miles from this St. Paul's Catholic Church, which is located at 22d Street and Hoyne Avenue. All the walls are stone up to and including a granite water table 18 ins. above grade. Above this water table all the walls are to be brick, built hollow. The entire exterior and interior, including vaulted floors and the lofty vaulted roof, are to be faced with special brick and terra-cotta of various colors. Several large finial crosses are to be terra-cotta, and copings and other trimmings will be of the same material. The splay molded sills and jambs of windows both outside and inside, the buttress caps, etc., and the vaulting as well as the plain wall surfaces are all to be of fire-clay stiff mud brick repressed and vitrified. The full-size diagrams of all these brick are being made in the architect's office. There are probably fifty different special shape brick. The standard adopted for a finished brick is $4\frac{1}{8}$ ins. by $8\frac{3}{8}$ ins. by $2\frac{7}{16}$ ins., the vertical mortar joints are allowed $\frac{1}{8}$ in., and the horizontal joints $\frac{3}{16}$ in. The archi-

TERRA–COTTA DETAIL, HUDSON BUILDING, 32 BROADWAY, NEW YORK.
Clinton & Russell and A. F. Leicht, Architects.
Executed by the White Brick and Terra-Cotta Company.

QUEEN INSURANCE COMPANY BUILDING, BROADWAY, NEW YORK CITY.
Geo. Edw. Harding & Gooch, Architects.
Face brick supplied by Sayre & Fisher Company.

tect's aim has been to make the building look what it is, a brick building, and in designing the terra-cotta ornament care was taken that it should not be an imitation of carved stone.

All the work is to be laid in imported Portland cement mortar. The piers carrying the vaulted roof are solid construction, not iron columns veneered with terra-cotta. Massive walls, instead of being filled with useless concrete, are hollow, carefully laid with thickness proportioned to imposed loads. The result ought to be both strength and economy. As for color, the exterior is to be a mottled mahogany, while the interior is to be treated in light shades of buff mottled, and with the mahogany color for trimming. Bricks are being delivered on the ground now.

The design shows a simplicity and beauty of composition, and yet a building so large and imposing that one thinks he is looking at a cathedral costing a half million of dollars. Imagine, then, one's astonishment when assurred by the architect that the church will be constructed and completed for $75,000! It might be added that the construction of this building is intended to be as nearly fire-proof as possible. The door frames are iron, while windows are minus frames and sash, the glass being set directly in the brick.

Work on the new government building has begun in earnest and is being pushed seven days in the week, and nights as well. This great excavation, a block square, busy with men, teams, and pile-driving apparatus, is now the center of all eyes in Chicago.

The Governor of Illinois has appointed the examining board of architects, the members being Mr. D. Adler, Mr. P. B. Wight, Prof. N. C. Ricker, Mr. Wm. H. Reeves, and Mr. Wm. Zimmerman. The effectiveness of the new law will depend in great measure on the efforts of this board.

In the way of building items we note: A mill and warehouse $160,000, by Flanders & Zimmerman; a factory, $50,000, by J. H. Wagner; a fire-proof office and theater building, by Inland Steel Company, $65,000; Wells-Fargo stable, $75,000, by M. L. Beers; Dormitory at Beloit, Wis., $30,000, by Patton & Fisher; Lehman apartment house, $200,000, by E. R. Krause; a row of twelve stone houses, $90,000, by H. L. Ottenheimer; apartment building, $25,000, by Pond & Pond.

NEW YORK.—That the immediate outlook for prosperity, or at least better times for the building and real estate trades, in this city is near may be inferred by the observant in connection with two very important kinds of transactions which have been the features of the past month.

The first is the selling of private houses to those who will occupy them. This is the healthiest sign that has shown itself in the real estate maıket in months. Purchases of this kind mean that small investors in considerable numbers have entirely recovered confidence and are ready to do business. The few sales already closed will inspire hesitating buyers to come forward with some assurance, and with the great improvement in general trade, and the splendid condition of the stock and grain markets, there cannot but be, at least, the beginning of an active fall season.

The second line of sales is not so gratifying. One of the leading New York papers is authority for the statement that New York has an oversupply of many kinds of structures. Flats and tenements there are in plenty, as thousands of vacancies testify, and in small low-priced dwellings the demand hardly equals the supply. Looking back on the work of the past spring and summer, the casual observer would naturally think that the architects must be very busy; but on investigation it is found that this large work is, as is perfectly proper, entrusted to those few who have attained a reputation for carrying on work of that kind, while it is a fact that those men whose special study is smaller work, residences, etc., are not terribly overworked, and there are still draughtsmen looking for jobs, which will probably be forthcoming to those who are worthy. Among the recent items of news are:—

A fifteen-story office building at 35 Broadway for the estate of A. Hemenway. It will be a

TERRA-COTTA DETAIL, PRESBYTERIAN BUILDING, PHILADELPHIA, PA.
Jos. M. Huston, Architect.
Executed by the Conkling, Armstrong Terra-Cotta Company.

brick building and will cost $800,000. Clinton & Russell are the architects.

The Medical Society of the county of Kings are holding a competition for a new club house to be erected on Bedford Avenue, Brooklyn, at a cost of $50,000. Drawings are due September 20. The building committee has appointed Frank Freeman, a practising architect, to be their professional adviser. This is not usually considered proper practise; but in this case we can assure competitors of fair treatment, as the architect mentioned is one who holds the honor of this profession above all thoughts of personal gratification.

A five-story brick business building will be erected on Prince Street, corner Marion, to cost $50,000. Richard Berger, architect.

Howard & Cauldwell, architects, have made plans for a $20,000 addition to the Ladies' Christian Union Building, 27 North Washington Square.

George Keister, architect, has planned a $40,000 addition to an eight-story brick and stone business building for Mr. J. B. Cole.

G. F. Pelham, architect, has made plans for a five story brick apartment house on Amsterdam Avenue, to cost $70,000.

Edward Wenz, architect, has planned three five-story brick flats and stores to be erected at Lenox Avenue and 113th Street, at a cost of $95,000.

M. J. Garvin, architect, has planned two five-story brick flats and stores to be built on 171st Street. Cost, $55,000.

Henry Anderson, architect, has planned a flat building to be erected on 115th Street, corner Seventh Avenue, at a cost of $90,000.

Neville & Bagge, architects, have planned five five-story brick flats to be erected on 115th Street, near Lenox Avenue, at a cost of $115,000.

C. B. J. Snyder, architect, has prepared plans for a five-story brick public school, to cost $220,000.

DUNN BUILDING, BROADWAY, NEW YORK CITY.
Geo. Edw. Harding & Gooch, Architects.

ST. LOUIS. — The revival of business throughout the entire West, and the improvement in local realty circles, although not affecting the architects much as yet, offers considerable encouragement, and it seems to be the feeling with every one that next year will be a busy one, and that work will commence early in the season.

During the last few months there has been a gradual increase in the value of the improvements that have been made, which have been of the character of flats and small residences in the outlying districts, but now the improvement or alteration of business houses, and the building of additions to factories, seems to be attracting considerable attention. Many of these improvements are of considerable importance; as, for instance, the alterations in the Southern and Hurst hotels, the erecting of a $90,000 factory by the Curtis Manufacturing Company, a $100,000 plant by the Brecht Ice Machine Company in North St. Louis, and a large ice factory by the Anheuser-Busch Brewing Company.

RESIDENCE AT MADISON, N. J.
Boring & Tilton, Architects.

Work has also been commenced upon several buildings where it was suspended last year on account of money matters.

John Conradi is the architect for the new Deutches Theater, which is being built on Broadway, between Market and Walnut Streets, at a cost of $40,000.

The transfer of 107 ft. of land on the north side of Washington Avenue between 9th and 10th Streets, and extending through 225 ft. to Lucas Avenue, was recently made, and it is reported that improvements in the way of a large wholesale house to cost nearly half a million dollars will be made. The building is to be occupied by the Hagardine-McKittrick Dry Goods Company, and work is to be carried on night and day to have it ready for occupancy by the first of May. Eames & Young are the architects. This location is fast becoming the center of the wholesale

dry goods and boot and shoe trade, and other improvements are under consideration.

The Barnes Medical College will open their school year in their new building on Chestnut and 31st Streets, which they have recently completed. The building is five stories and basement, in the Italian renaissance style of architecture. Buff brick and white stone have been used in the exterior. J. B. Legg was the architect.

TERRA-COTTA DETAIL, MAIN ENTRANCE, ST. JOHN'S CHURCH, JOHNSTOWN, PA.
Beezer Bros., Architects.
Made by the Standard Terra-Cotta Company.

PITTSBURG. — The outlook for building during the fall is far more promising than it has been for several years. So great has been the demand for building permits, and so decided and general the opinion that building operations will assume vast proportions in the near future, that property has been affected in all sections of the city, and values will naturally be enhanced materially. Preparations and plans are being made for the erection of a market house in the East End, by a new corporation, under the title of "The Liberty Market." $200,000 will be spent; steel framing, Pompean and white enameled brick will compose the structure, and all modern improvement and convenience will be installed. A charter was issued at the State Department at Harrisburg for the Bellefield Company of Pittsburg, which proposes to erect a hotel near the entrance of Schenley Park. The capital stock is $300,000. The plans have been prepared by Architects Rutan & Russell, for a modern building in every particular.

Architects Vrydagh & Wolfe; Struthers & Hannah; J. L. Beatty; Bartberger & East; and E. E. Miller, have submitted sketches for the U. P. Shadyside Presbyterian Church.

Architect Charles Bickel is receiving bids for the erection of the Majestic apartment house, at Butler and 35th Streets, for Capt. M. A. Cutter, to be five stories, pressed brick and terra-cotta.

Architects Vrydagh & Wolfe are preparing plans for a brick colonial residence for W. L. Smith on Morewood Avenue, to cost $10,000.

Architect J. N. Campbell is preparing plans for a $10,000 buff brick colonial residence at Crafton for James McAleer, Esq.

Plans are being prepared for a new school building for the 10th ward, Allegheny, to cost $125,000.

Architects Rutan & Russell are preparing plans for a hotel at Sewickley.

George Booth, of the Department of Charities, has had plans prepared for a brick building for children at the poor farm at Marshalsea.

Architect J. E. Obitz is preparing plans for a brick church to be erected at Tarrentum for the Trinity Evangelical Lutheran congregation.

Architect U. J. L. Peoples's plan for the new high school at McKeesport has been accepted.

NEWS FROM THE BUSY.

THE Pioneer Fire-proof Construction Company, of Chicago, have taken a new suite of offices in the Marquette Building.

IN our last month's Boston letter, it was reported that Mr. George B. Rogers was the architect of the new Times Building, at Hartford. We have since learned that Mr. A. W. Scoville is the architect of the building, Mr. Rogers being in his employ as draughtsman at the time that the plans were being made.

MERCANTILE BUILDING, ST. PAUL, MINN.
Cass Gilbert, Architect.

CHARLES T. HARRIS, Lessee, will supply the Celadon roofing tiles for the following new buildings: —

Residence for N. W. Bowen, Delphi, Ind.; Dauphin Park School Building, Chicago, Ill.; residence for Mrs. A. H. Armour,

RESIDENCE AT PITTSBURG, PA.
Alden & Harlow, Architects.
Face brick manufactured by the Harbison & Walker Company.

RESIDENCE AT MADISON, N. J.
Boring & Tilton, Architects.

Kansas City, Mo.; Railroad Station, at Franklin, Penn.; Biological Building, Columbus, Ohio; Susquehanna Avenue Church, Philadelphia, Penn.; residence, Newark, N. J.

WE have had sent us by the Powhatan Clay Manufacturing Company, a sample of their new silver-gray brick. In shade and texture it is an ideal brick which shows that same excellence of manufacture that has made the cream-white brick, made by this company, so popular.

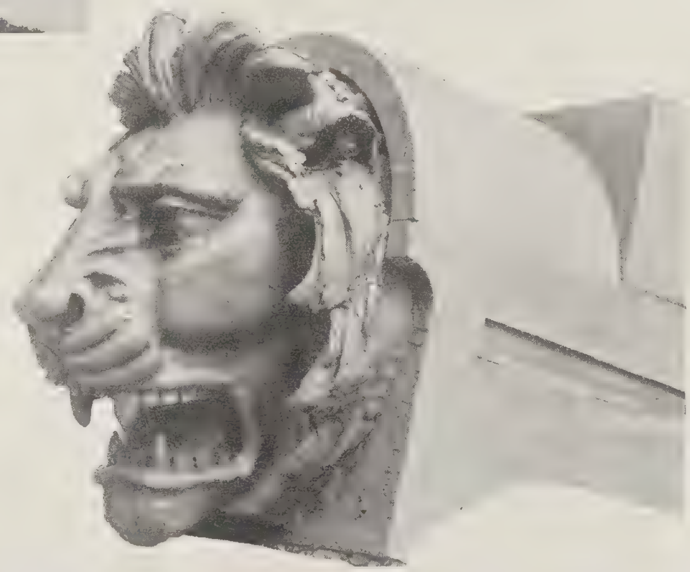
THE "Brooklyn Bridge" brand cement was specified on the thirty-story office building, on Park Row; R. H. Robertson, architect; John Downey, general contractor; Dawson & Archer, masons. The latter have adopted this brand of cement, and it will be the only Rosendale cement used in the construction of what will be the largest office building in the world. It may be also stated that this brand was the only Rosendale cement used in the largest hotel in the world, the "Astoria."

CHAMBERS BROTHERS COMPANY, of Philadelphia, report decided improvement in inquiries for brickmaking machinery within the past two months, and have booked an order for machinery to go to South America, and have recently shipped another of their well-known automatic end-cut brickmaking machines to Europe. They are very much gratified with the interest taken in their new steam-power repress for plastic brick, and have received two orders for this press within a few weeks. It is illustrated on page xl of this issue, and weighs about 14,000 lbs.

CENTRAL MOTIVE, DENTAL HALL, UNIVERSITY OF PENNSYLVANIA.
Edgar V. Seeler, Architect.
Executed in Terra-Cotta by the Conkling, Armstrong Terra-Cotta Company.

THE PHILADELPHIA AND BOSTON FACE BRICK COMPANY report that their business is better than it has been for years past. They are running a very large force of men at their works in Charlestown, and say that their brick mantel business the last week in August was the largest in the history of the company. In all their departments the demand is so great for their goods (which are sent to all parts, not only of the United States, but of the world) that they may have to run extra time to fill their orders.

THE following is a list of new buildings, for which the White Brick and Terra-Cotta Company have furnished the architectural terra-cotta:—



TERRA-COTTA LION'S HEAD IN CROWN MOLD OF CORNICE OVER 12TH STORY ST. JAMES BUILDING, BROADWAY, NEW YORK CITY.
Bruce Price, Architect.
Executed by the Perth Amboy Terra-Cotta Company.

Hospital for Crippled and Ruptured, Lexington Avenue and 43d Street, New York; architect, C. C. Haight. Addition to Normal School, Jamaica, L. I.; architect, I. G. Perry. Mercantile Building, 134–138 Mott Street, New York; De Lemos & Codres, architects; "The Washington Irving" apartment house, 112th Street, near 7th Avenue; architect, George Keister. Hudson Building, 32–34 Barry Street, New York, Clinton & Russell and A. F. Leicht, architects, Mercantile Building, 10th Street and University Place, New York; architect, W. J. Dilthey. Mercantile Building, 7 Great Jones Street; architect, L. Korn. Memorial Chapel, Wellesley College, Wellesley, Mass.; architects, Heins & La Farge.

FISKE, HOMES & Co. report an active demand for their light brick specialties, sales for August being largely in excess of previous month.

Amongst principal orders booked are:—

Extension of Hotel Reynolds, Boylston Street, Albert Geiger, Esq., owner, Arthur H. Vinal architect; the Home for Incurables, Cambridge, Mass.,

W. H. and J. A. McGinty architects; United States Post-Office, Lynn, Mass.; chapel and office, Mt. Auburn Cemetery, W. A. Sears architect; Mercantile Building, Merrimac Street, Boston, T. E. Clark

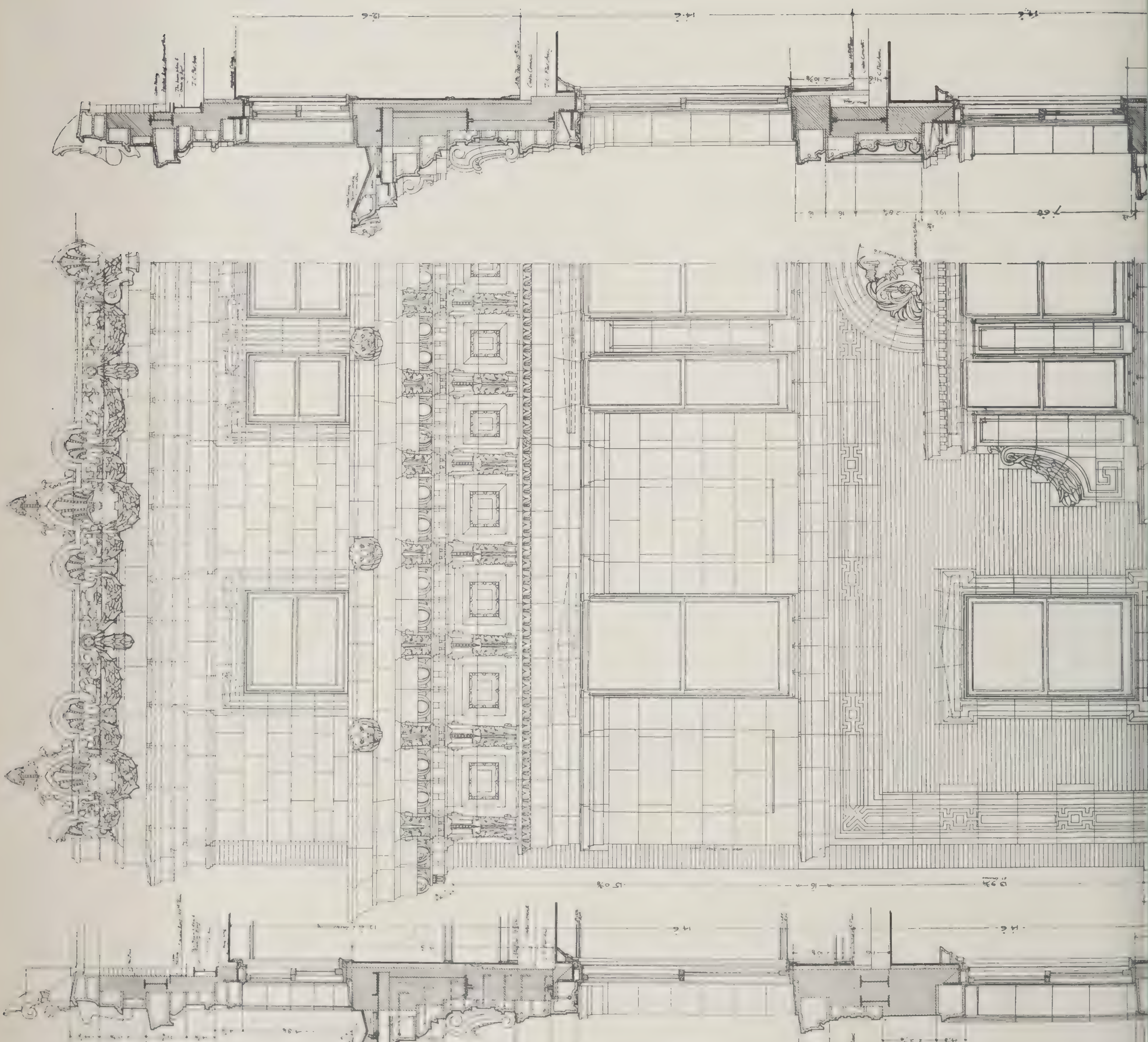
PORTION OF PARAPET RAIL, C. WEYAND BREWERY, BUFFALO, N. Y.
Geo. J. Metzger, Architect.
Executed in terra-cotta by the Northwestern Terra-Cotta Company.

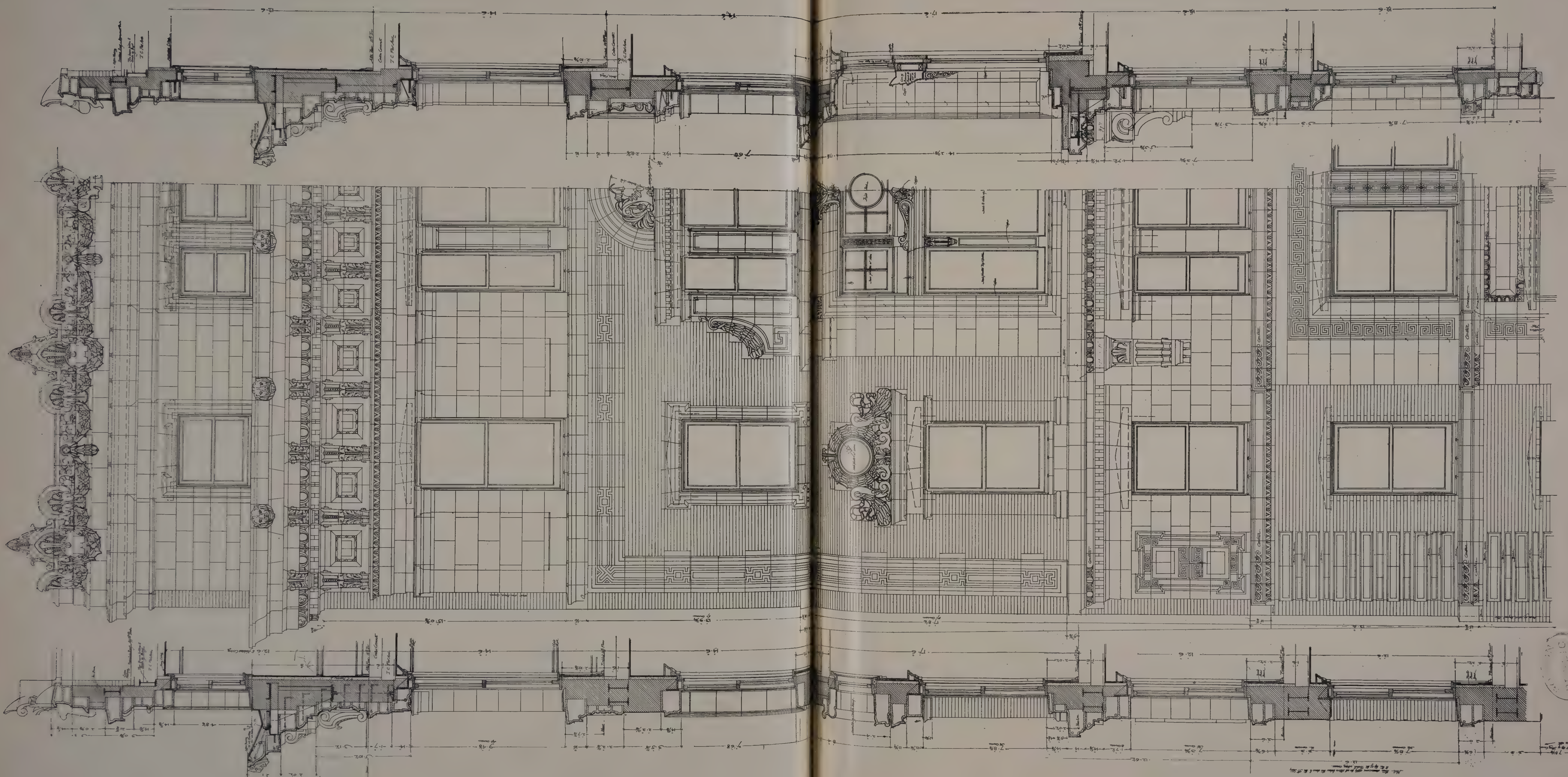
architect; Mercantile Building, Main Street, Cambridge, Mass.; Twombly Block, South Framingham, Mass., C. E. Barnes & Co. architects; Legal Chambers, Spring and Poplar Streets, Boston, F. A. Norcross architect; Slocum Block, New Bedford, Mass., Nat C. Smith architect; extension of Parker House, New Bedford, Mass., Nat C. Smith architect; private residence, Cambridge, Mass., H. Langford Warren architect; business block, Lawrence, Mass.; Galvin's Block, Exeter and Boylston Streets, Boston; residence, New Haven, Conn.; barn for Springfield Street Railway Company, Springfield, Mass., brick and terra-cotta, Gardner, Pyne & Gardner architects; Tyler Block, New Haven, Conn.; Besse Block, Springfield, Mass.; together with about fifty apartment houses, business blocks, and private residences in Boston and immediate vicinity, taking approximately one million bricks.

We are in receipt of some very handsome blotters from the Clinton Wire Cloth Company, of Clinton, Mass.

It is the intention of the company to mail a new blotter each month to all parties interested in the use of wire cloth for building or other purposes. Any parties desiring to receive them regularly may have their names put on the list by sending their address to the Clinton Wire Cloth Company, Clinton, Mass.



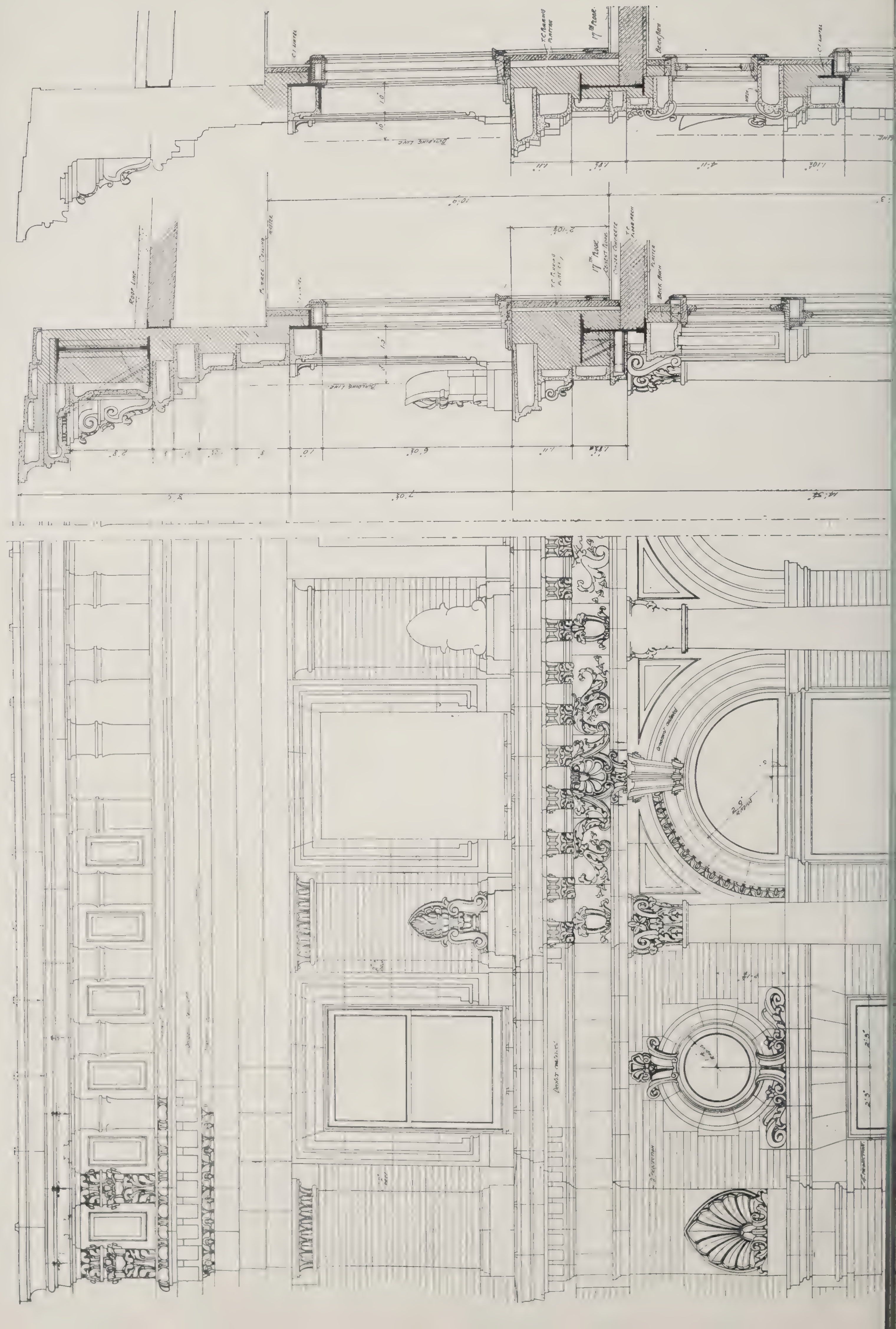


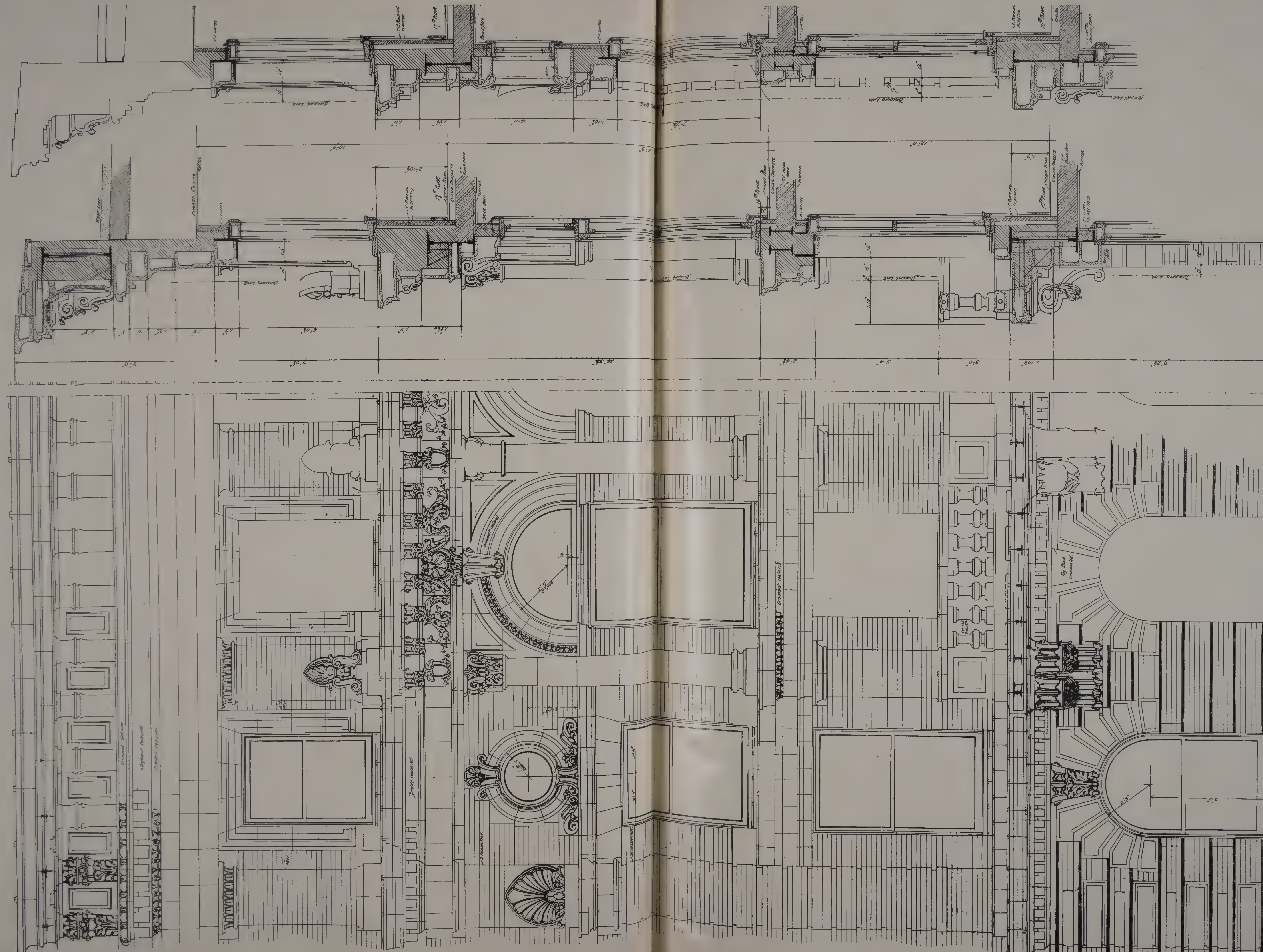


DUN BUILDING, BROADWAY AND READE STREET, NEW YORK CITY.

DETAILS OF TERRA-COTTA WORK, ETC., UPPER STORIES. ILLUSTRATION OF PERSPECTIVE SHOWN IN LETTER-PRESS PORTION OF THIS NUMBER.

GEO. EDWARD HARDING & GOOCH, ARCHITECTS.





QUEEN INSURANCE COMPANY BUILDING, BROADWAY, NEW YORK CITY.

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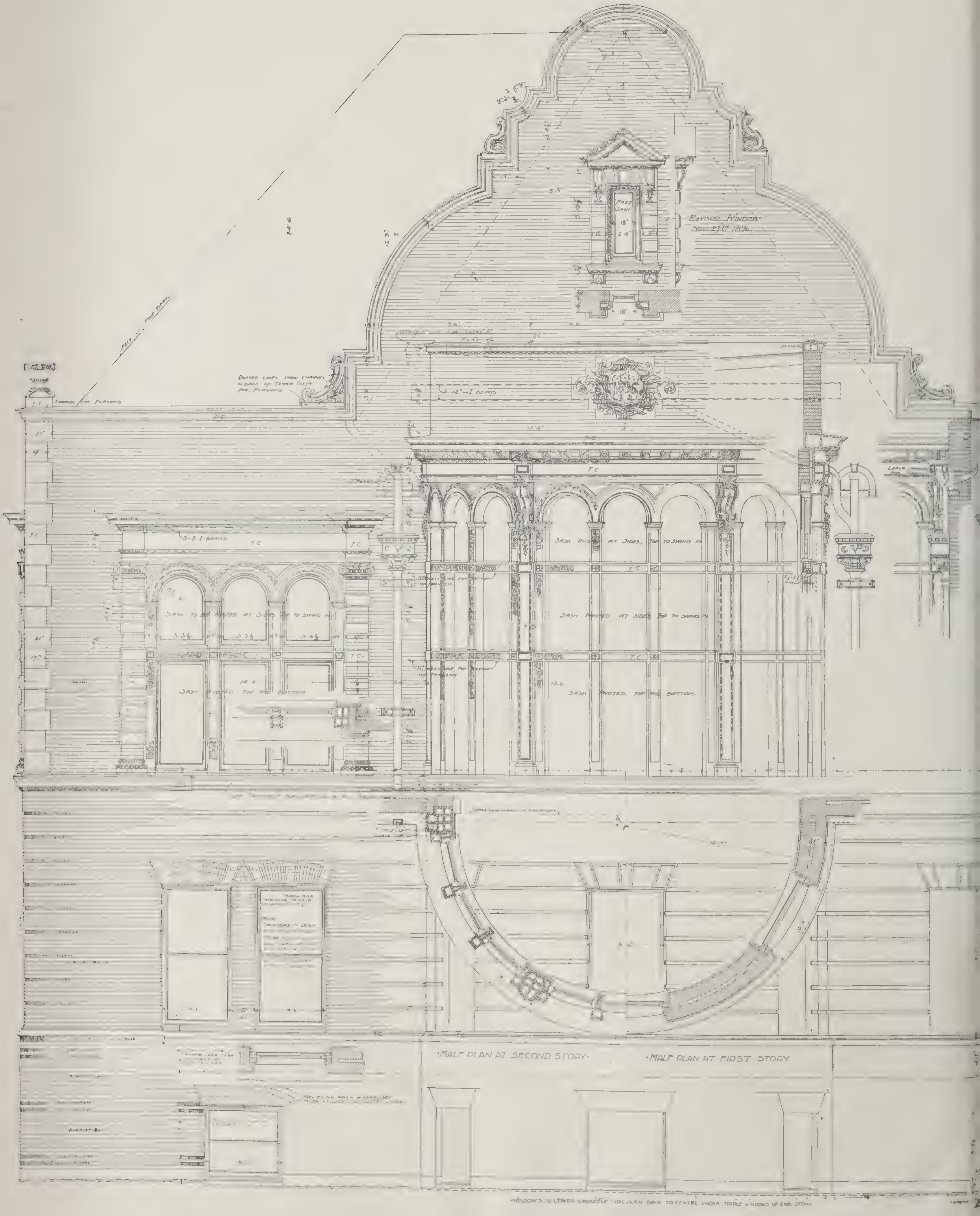
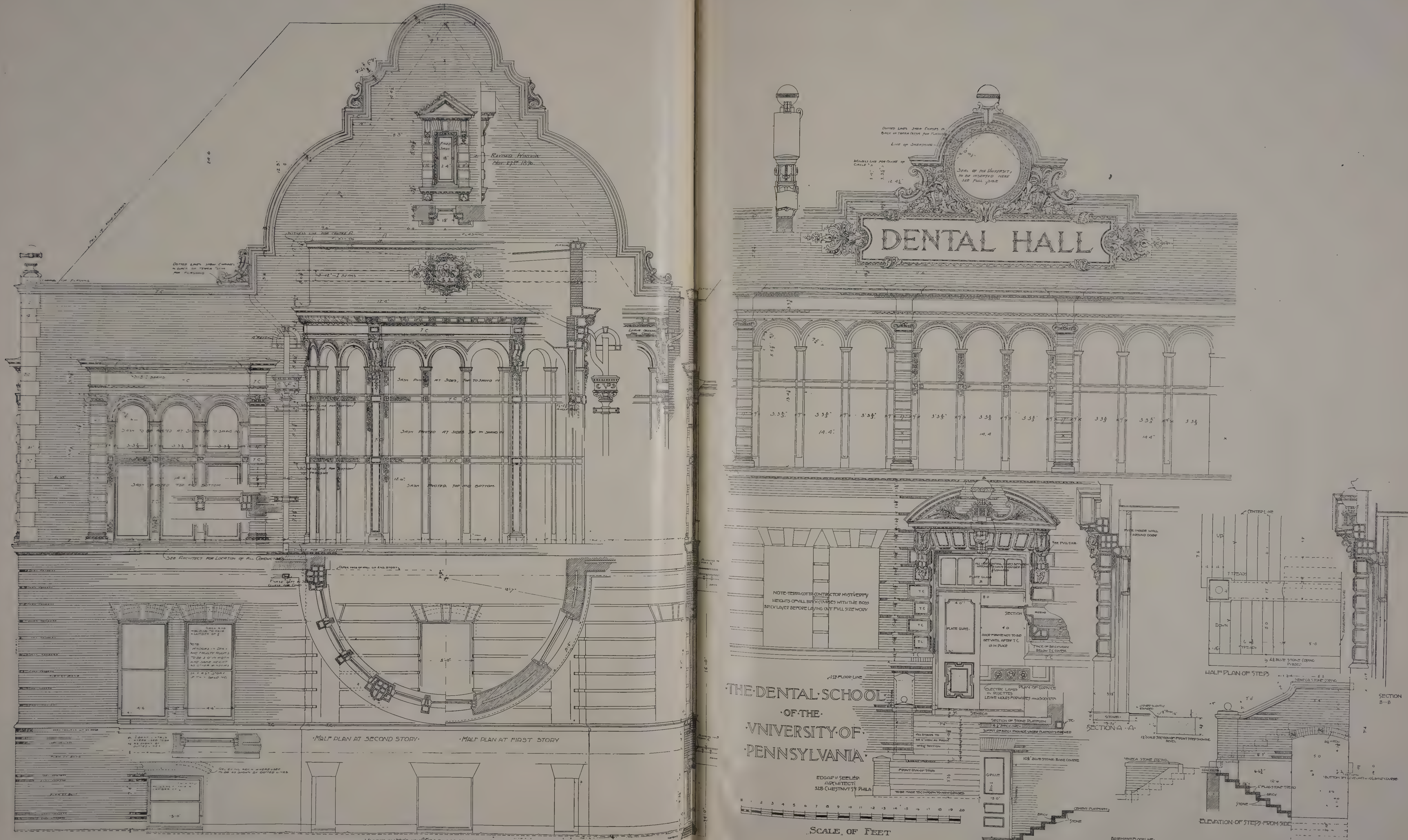


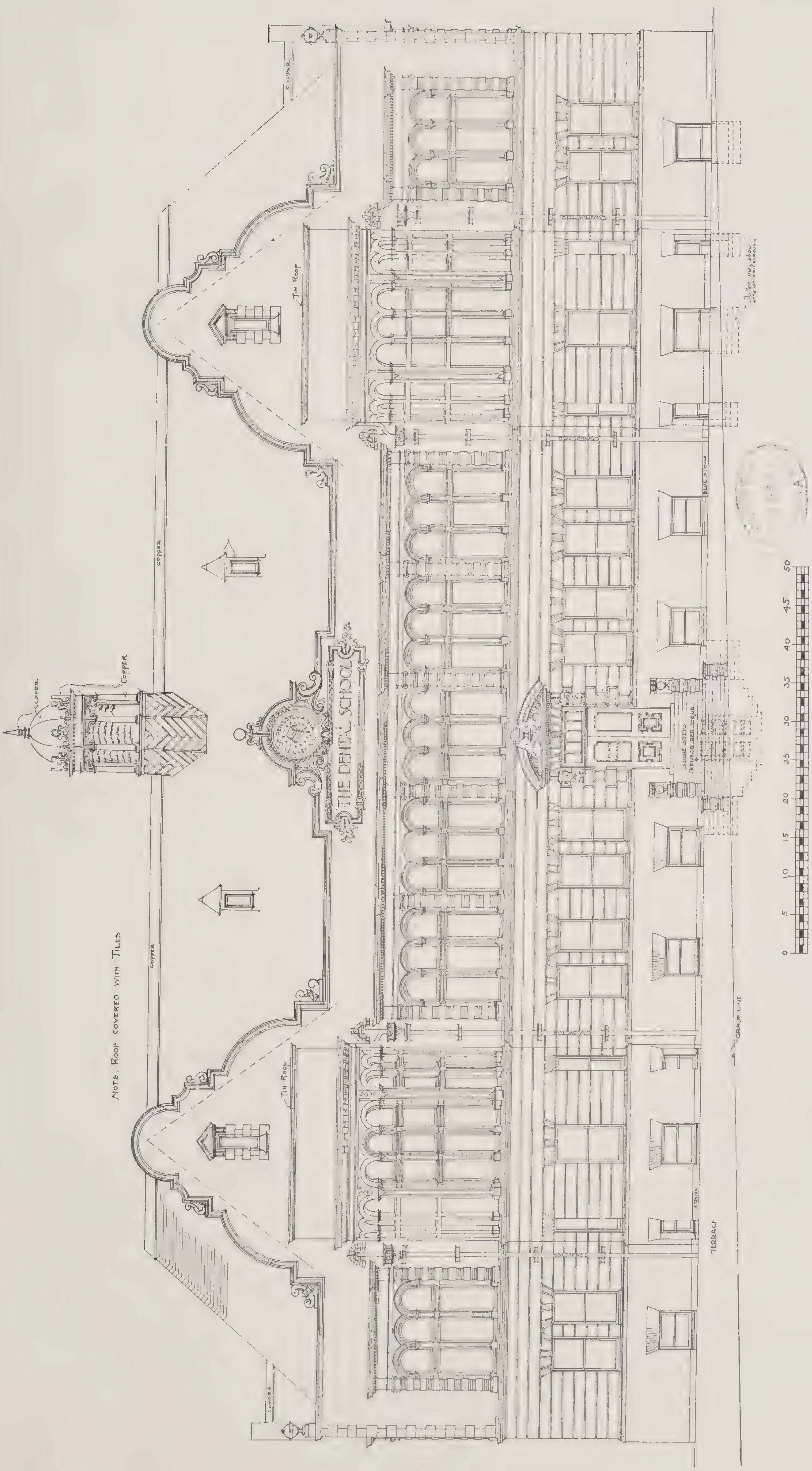
DENTAL SCHOOL, UNIVERSITY
EDGAR V



DENTAL SCHOOL, UNIVERSITY OF PENNSYLVANIA, PHILADELPHIA, PA.
EDGAR V. SEELER, Architect.

DENTAL SCHOOL, UNIVERSITY OF PENNSYLVANIA, PHILADELPHIA, PA.
EDGAR V. SEELER, Architect.

PLATES 79 and 80.



Scale of Feet

Front Elevation.

DENTAL SCHOOL, UNIVERSITY OF PENNSYLVANIA, PHILADELPHIA, PA.

EDGAR V. SEELER, Architect.

VOLVME VI OCT. 1897 No. 10

THE BRICKBVILDER

OFFICE 85 WATER STREET BOSTON

THE BRICKBUILDER.

AN ILLUSTRATED MONTHLY DEVOTED TO THE ADVANCEMENT OF ARCHITECTURE IN MATERIALS OF CLAY.

PUBLISHED BY

ROGERS & MANSON,

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P. O. BOX 3282.

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THE BRICKBUILDER is published the 20th of each month.

IN colonial times, and down to a comparatively recent date, to lay brick in Flemish, or in English bond, was a common practise. Specimens of both may still be seen in the older parts of nearly all of our Eastern cities; but we fear that what was formerly a rule — and a very good rule, too — has long since become the rarest exception. This is especially true of New York, where, of all the work done by the present generation of builders, we know but a few righteous examples.

America has gained immensely in many things by adopting the good, rejecting the bad, and avoiding the mistakes of older nations. In the bonding of brickwork this wise policy seems to have been reversed. Notwithstanding the force of both precept and example, we have contracted the inexcusably bad habit of laying brick in vertical tiers, with little more than a pretense at bonding. Worse still, we seem inclined to pursue this retrograde and dangerous career in spite of all warning and remonstrance. The sham that goes under the name of "American bond," and at which people who have seen it for the first time laugh ironically, has not the poor merit of being a successful delusion. Nobody, we suppose, is expected to believe that the four inches of face brick, in which no headers are permitted to appear, can be counted in as an integral part of the wall's thickness. A brick-mason of some thirty years' experience in England assured us, not many days ago, that "to face a wall without using *bona fide* headers is a thing utterly unknown there, — except as a criminal offense." We hope that here, too, there is a time coming when it will be classified in the same category, and similarly branded in public estimation.

The first, but we think the only practical difficulty encountered in this is the various sizes of face brick now in general use, and the want of corresponding sizes of common brick to work with them. These sizes, however, resolve themselves into two classes, the one being a brick of $2\frac{5}{16}$ ins. average thickness, which, with a $\frac{3}{16}$ joint, will course at a common multiple of $2\frac{1}{2}$ in. centers. The other, but much smaller class, comprises the various kinds of Pompeian brick, the approximate thickness of which may be set down at $1\frac{1}{2}$ ins. This with a mortar joint of $\frac{3}{16}$ gives us $1\frac{11}{16}$ ins. as the unit of measurement. It is with the latter class that the obstacles to be overcome appear most formidable; but they are only apparent, and in both cases can be made to vanish.

One way in which this may be done is to have common brick made to the same thickness as the face brick; or just a trifle less, to allow for a necessarily greater degree of irregularity in the bricks, and a more liberal use of mortar in bedding them. That a demand for common brick to be used in this way exists may have been gleaned from many inquiries made by architects from time to time, echoed by THE BRICKBUILDER, and reechoed by some of our contributors. We would be glad to see that demand grow more general and insistent on their part. It would be an encouraging evidence of good intentions, and an augury of awakened interest. We can answer for the brickmaking fraternity that the supply would soon be forthcoming. The movement would be supported by all well-conditioned builders, as nobody knows better than they do the indefensible character of prevailing practises.

So far as the architects are concerned we have given them credit for good intentions, but these of themselves are inadequate. They are entitled, and by virtue of their office empowered, to do more than this. They should insist upon having the kind as well as the quality of material necessary to produce work that will be lastingly serviceable to their clients; therefore creditable to their own judgment, forethought, and integrity. They are supposed to know, and as a rule they do know what is right in such matters; it is equally incumbent upon them to point the way, and to see that the desired end is substantially attained. If not by a faithful discharge of these duties, then we would willingly listen to such other reasons (if any) as may be adduced in vindication of their existence.

It is the policy of this journal to find a market for good materials, and encourage those who seek to propagate honest methods of using them. Not everything that is offered comes up to this standard, but we have not found it at all necessary to single out individual men or things for invidious criticism, much less wholesale denunciation. We have been content to advocate and uphold that which is beyond reproach; leaving that which is otherwise to perish, as it ought, and as it undoubtedly will, from lack of patronage. Pursuing the present subject in a similar spirit, towards a tangible conclusion, we invite feasible suggestions in further elucidation of this question of brick bonding. We anticipate for them, on behalf of our respected readers, a discriminating appreciation, if not a willing acceptance. In any event, their sponsors shall have the opportunity of addressing a large and interested audience, whom we have reason to believe regards the question at issue as one ripe for discussion.

WE are so slow in this country to appreciate the value of proper esthetic treatment of our public work that it comes almost as a matter of course that, when a great undertaking which is primarily of a utilitarian character is undertaken by a municipality,

the result, however satisfactory from a standpoint of mere prosaic fitness, is pretty sure to be hopelessly inartistic. Our lost opportunities are legion, and to them must be added the Boston Subway. This was a piece of work which from its very nature would suggest the use of brick masonry. The past is so full of instances wherein vaulted structures have been made both practical and attractive, and it would seem so natural a desire on the part of our commissioners to at least attempt a species of good looks in connection with subterraneous constructions, that the utter lack of any attempt at anything more than a strictly utilitarian treatment of the problem is certainly disheartening. The stations where the public is supposed to enter and leave the cars — we refer now to the underground portions — are spacious, well arranged, and, considering the conditions, excellently well lighted. We have every assurance that the supporting members are well proportioned and the structure, as a whole, perfectly stable. But the rank Philistinism which would utterly ignore such a splendid opportunity for striking architectural effects as these stations offer is certainly to be deplored. The commission, in its inscrutible wisdom, has seen fit to employ glazed brick quite extensively as a facing to the walls of the stations. So far this is excellent; but not the slightest attempt has been made to do anything more than face a barren, uninteresting wall with a dead-white glazed surface. The isolated columns, the iron girders, the brick arches between the beams, all stand out in naked insistence, and the daily traveler through the subway can find nothing more attractive to cheer his eye than the dreary reflections of white from the paint on the columns, the enameling on the beams, and the glazing on the bricks. It is surely not from lack of precedent that the opportunity has been neglected. One has only to go through the new Public Library Building to see how strikingly successful effects can be obtained by combinations of vaulting with the use of either the Guastavino arches or some kindred form of brick or terra-cotta. The subway has been well built, well planned, and has been in the hands of a commission which was able in every respect except in its ability to appreciate the desirability of good looks. In this respect the subway stations present a dismal, hopeless failure.

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public, fulfilling as many of their requirements as possible, and increasing the revenue of the company as well as the architectural beauty of the city.

MR. EDMUND M. WHEELWRIGHT'S series on American Schoolhouse Architecture will begin in the November number of THE BRICKBUILDER. The series will comprise probably four articles, which will be published in consecutive issues. Mr. Wheelwright's superior knowledge of the subject, gained by a thorough study of foreign methods of planning and construction, and his experience as city architect of Boston, at a period when many of its best schoolhouses were built, should make this series of added interest and value.

ILLUSTRATED ADVERTISEMENTS.

PANEL executed by the New York Architectural Terra-Cotta Company. Gardner & Pyne, architects. Louis Roncoli, modeler.

The accompanying panel is suggestive of modern locomotion in its latest phase of development; it is likewise more realistic than symbolic in point of conception. This will become sufficiently apparent when it is stated that the panel is intended to be placed over the entrance to a building now in course of erection for the Springfield (Mass.) Street Railroad Company.

To model in perspective a series of scenes, giving the principal features a certain degree of relief, and to treat the subject so that the composition as a whole may appear correct in its lines, when it, in turn, is seen in perspective from various points of view, is a task that has never yet been fully accomplished. The difficulties are inherent, and, beyond a certain point, may be considered insuperable. The best that can be done is but a well-balanced approximation to the truth, and this is as far as Mr. Roncoli has essayed in the present instance. His famous countryman, Ghiberti, did not accomplish much more than this in his bronze gates at Florence, which, though an acknowledged masterpiece in their way, have often been questioned as to the convergence of the vanishing points.

PERSONAL AND CLUB NEWS.

MR. J. C. NIEBEL, architect, 59 Court Street, Brooklyn, N. Y., succeeds to the business of Carl F. Eisenach, who retires from practise.

MR. HAROLD F. ADAMS, architect, formerly associated with Mr. Wm. G. Hoopes, Atlantic City, N. J., has opened an office in the Real Estate and Law Building, Atlantic City, and would be glad to receive catalogues.

THE second annual redesigning competition, held by the T Square Club, of Philadelphia, called for the redesigning of the Reading Railroad Terminal, "under conditions which the citizens of Philadelphia had every right to expect and demand. In consideration of the privilege of building over the streets, which the city owned, councils should have insisted upon the acquirement by the railroad company of the entire block from 11th to 12th Street, and from Market to Filbert Street, and also upon the proper recession of all fronts so as to accommodate the accumulated traffic," says the program. Some of the conditions were: one or more courts of approach; accommodations for shops, stores, a bank, and such trades as would necessarily have to be provided for in this rearrangement; facilities for checking bicycles, and their convenient storage, etc.; waiting places for street cars; hotel accommodations. In general, the building should be considered and arranged to be a central place of convenience for the

In their advertisement, page xiv, R. Guastivano Company show a cut of their large roof construction, being the fourth recently built for the West End Street Railway, of Boston, for their power stations. The cut shows the roof in process of construction, after which the haunches of the arches are concreted over the beams, and the whole surface asphalted and graveled. It is similar in construction to the roof built by them for the Union Railroad Company, of Providence, the Colorado Telegraph Company, and others.

No. 4 of the series of brick and terra-cotta fireplace mantels which is being illustrated in the advertisement of Fiske, Homes & Co., page vii, is one designed by J. A. Schweinfurth, architect, and modeled by Tito Conti, the drawing being by H. F. Briscoe.

The always interesting building of the Exchange Club, Boston, Ball & Dabney, architects, is illustrated in the advertisement of the Boston Fire-Proofing Company on page xi.

The Harbison & Walker Company illustrate in their advertisement for this month, on page xxv, the Conestoga Building at Pittsburg, Penn., Alden & Harlow, architects.

A section of a wall laid up with seam-face granite is shown in the advertisement of the Gilbreth Seam-Face Granite Company, page xxxviii.

Many other advertisements which appear in this month's number have interesting illustrations which have been mentioned before in this column.

Some Important Problems in Construction. I.

BY WM. W. CREHORE, ASSOC. M. AM. SOC. C. E.

THE title selected for these studies is perhaps not as truly significant or descriptive as it might be, since it is the writer's intention more particularly to discuss what not to do and why than to enter upon the statement and solution of any of the numerous problems which are presented by the various conditions of modern construction. General questions as to which of two or more alternatives is the best and most economical might, however, quite properly be propounded like problems for solution, and with this explanation the title may perhaps be allowed to apply.

One of the first things to be decided in designing the skeleton frame of a fire-proof building is whether to use cast-iron or built-steel columns. If the building is to be a high one, or one whose height is many times its least dimension, the necessity for some effectual system of wind bracing will preclude the use of cast-iron columns; for wind bracing must be riveted and fastened to connecting members by rivets, whereas rivets cannot be driven in cast iron without liability of cracking it. Everything considered, perhaps the best and safest course to pursue is to reject cast iron altogether and proceed to use steel throughout; but at present prices, as long as the law does not absolutely prohibit the use of cast iron, there are certain limits between which it is safe and a little less costly than steel. These limits are not by any means to be determined off-hand, nor, unfortunately, by the legal limitations of the use of cast iron. A safe designer will take into account the possibility of making details of connections which will be fully as strong as the members connected.

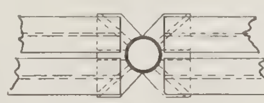


FIG. 1

Fig. 1 shows a 6 in. cast-iron column carrying a 12 in. double beam girder on each side. The total width of this girder over flanges being a little more than twice the diameter of the column, it becomes a serious problem to design a seat and brackets which will convey the load into the body of the column. Fig. 2 represents the same thing in a worse form, as the loads come from adjacent instead of opposite sides of the column, and this eccentric loading causes an additional moment in the shaft of the column. Cast brackets and seats in cases like these are out of proportion to the size of the column, and must of necessity be clumsy and unsuitable, to say the least. The column, although theoretically of sufficient size for the imposed loads were they laid vertically on its shaft, is not large enough to receive them through side brackets.

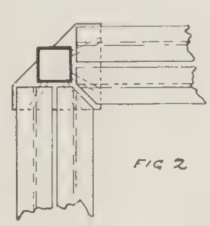


FIG. 2

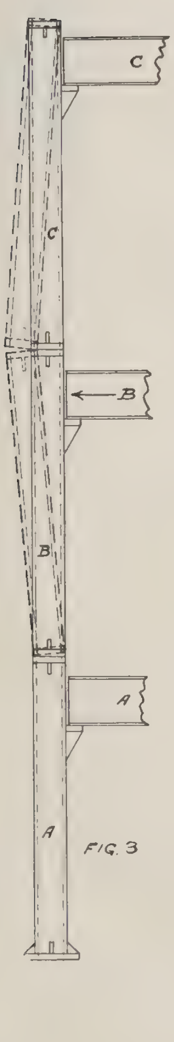
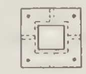


FIG. 3

Six or seven inch cast columns are seldom made thicker than one inch, because the same amount of metal put into a larger sized column is more economical. A small column 1 in. thick reduced to three quarters of an inch on one side by the shifting of the core, as is frequently the case, is not heavy enough to withstand the pull of 1¼ and 1½ in. seats and brackets attached to it. The metal in the body of the column in the immediate vicinity of the bracket is more severely stressed than any other portion of the column or the bracket itself, and the tendency of the seats and brackets to pull out of the column is increased. This might have been theoretically inferred, but it is confirmed by observation of cast column failures of recent years.

It seems clear from the preceding remarks that the use of small cast-iron columns is often accompanied by considerable risk, even when they are most carefully designed and used within the legal limitations. In the writer's opinion, the "line" should be "drawn" at the 8 in. column, and nothing smaller should be used except in very rare instances where the loads can be symmetrically imposed. This limitation having been determined, it will be found a little less costly at present prices to use riveted steel columns in the three or four top stories of an ordinarily loaded building, and this method has also the advantage of stiffening the building where stiffness is most needed to resist wind forces. These upper story columns may be made of four angles and a plate, or of four angles latticed. To produce the desired rigidity, all beam and girder connections to them as well as their connections to each other should be riveted.



On the other hand, the 16 in. cast column may be taken as the upper limit. Beyond this steel box columns can be built of angles and plates to better advantage and will be found less costly. In the manufacture of very heavy cast columns it is difficult to keep the core from shifting considerably, owing to the increased action of gravity on the molten metal, causing it to flow underneath and buoy the core up. Then, too, imperfections are less easily detected in heavy castings, and one cannot be as certain of getting good material.

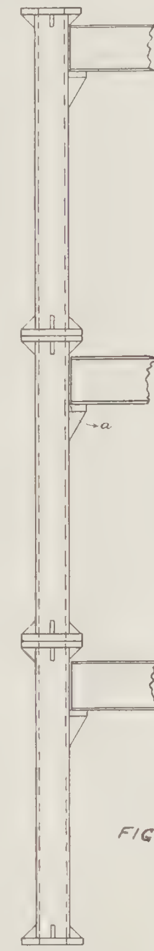


FIG. 4

A shaft made up of a number of cast columns is very dependent on the flange connections for its stability. Fig. 3 shows an error (much too common among designers) whereby the stability of the shaft is practically reduced to zero. The column flanges should extend equally in all directions, as shown in Fig. 4, and not in two opposite directions only, as in Fig. 3. A thrust along the line of the beam at B would tend to separate the two columns B and C, and to cause them to take the positions indicated by the dotted lines. The only possible advantage to be gained in this side flange construction is in case of columns built in the wall to permit the brickwork to pass more easily around them, but the risk is too great and it should never be allowed. Column flanges should be reinforced also by small 45 deg. brackets, as shown in Fig. 4, and the bolts should be located as far out as possible in each direction for the purpose of increasing the column's stability or of broadening its base (which amounts to the same thing).

Another error, not now so common as it used to be, is the use of shallow brackets under the beam seats. A 45 deg. bracket for this purpose is too shallow. The depth of the bracket not only affects the resistance of the material to the external shearing forces, but also determines the tensile stress at the point where the seat joins the main body of the column, that is, at the point a in Fig. 4. The deeper the bracket the less this tensile stress becomes for a given load. If we assume the bracket and seat together as one rigid body, then the load from the beam acting downward at P (Fig. 5), a distance x from the column, causes a pull or a tensile stress along the line of the force H and in the opposite direction. It will be easily seen that the amount of this pull, H, is dependent for a given load, P, upon the two distances x and y (or rather their relation to each other), and that this pull increases as x increases, but decreases as y increases. Multiplying each force by its per-

pendicular distance from the point a and equating these products, we have

$$Hy = Px,$$

giving the amount of the pull

$$H = P\frac{x}{y}.$$

Although, strictly speaking, the strain does not all reach the column in the line of H, but is distributed along the whole height of the bracket, still much the greater part of it must be resisted by the metal in the line of the force H, and the deeper the bracket the less this force is. With a 45 deg. bracket the force H is just equal to the load P, and diminishes as the angle between the seat and the bracket increases. These brackets are now usually made with a 60 deg. slope.

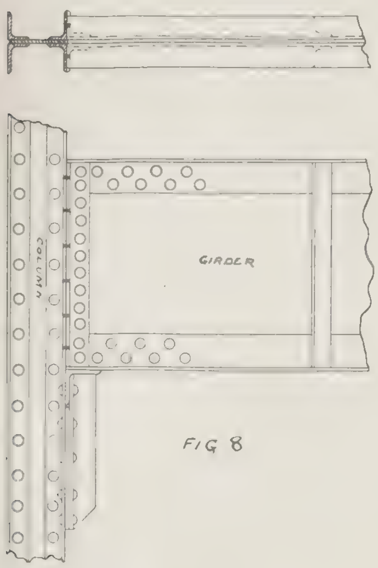


FIG 8

In the preceding discussion the load is assumed to be applied at the very tip end of the column seat, and were the beam to deflect, however slightly, this would be the actual point of its application. To prevent this and thus add strength and stability by applying the load close to the column, the seat is often made slightly sloping (see dotted lines, Fig. 5), say $\frac{1}{16}$ to $\frac{1}{8}$ in. to the foot, just enough to exceed the largest anticipated deflection of the beam.

A similar line of reasoning applies to the brackets or webs of a cast-iron shoe. Such a shoe as is represented in Fig. 6 is too shallow for its width, and the lower flange is subjected to a greater tensile stress at a than that of a deeper shoe would be, as in Fig. 7. A slight unevenness in the grouting of a cast-iron shoe is not an unusual occurrence, and as it is sure to set up irregular and almost incalculable stresses in the metal, a shoe should be designed with an ample factor of safety to begin with. This, it should be noted, does not mean that the metal should be used wastefully merely to increase the weight of the casting, but that it should be properly placed where it will do the most good. The commonest errors are making the shoe too shallow and placing the brackets or webs too far apart, thus weakening the lower flange or base-plate. A slope of 60 degs. usually figures out about right for these shoe brackets also.

Another reprehensible practise is that of leaving columns (especially cast columns) unbraced or insufficiently braced in one direction. It nearly always happens that the principal loads to be carried come from opposite sides of the column only, but it is quite essential, both for economy and stability, that the lesser loads coming from the other directions should be so spaced that a pair of them may be directly supported by the columns, and of the intermediate pairs none should load the girder at its center.

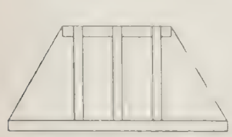


FIG 7.

In strictly fire-proof construction, where all the beams and columns are of metal and the floors of some solid material, the structure is usually rigid enough if its base is not too narrow; but in a combination semi-fire-proof structure of cast-iron columns, steel girders, and wooden beams, where the beams rest on top of the girders, there is almost no lateral stiffness through the whole length of a line of girders unless special stiffening beams are placed between all columns in the direction at right angles to the girders.

There is a frequent tendency to use the girders in this kind of construction on very long spans, which of course means on spans which bear a high ratio to the depth of the girders. Theoretically there is a fixed limiting span up to which a beam of a given depth may be used with its maximum allowable loading before excessive deflection will take place. In fact, the amount of deflection for quiescent loading may be accurately calculated beforehand. But practically ordinary loading is not always quiescent, and the effect of suddenly applied, moving, or vibratory loads increases disproportionately with the length of the span; so that where any possibility of such loading exists the girders should be made on the longer spans proportionately much deeper than required by the theory of flexure.

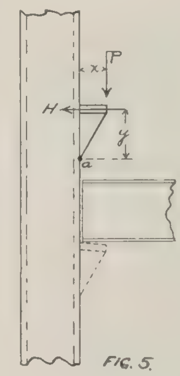


FIG. 5.

In using girders three or four feet deep their ends should be rigidly connected for their full depth, and not left simply to bear on the column's seat, and perhaps with an additional bolt or two at the top of the girder. Such ineffective connections do not develop the girder's full strength under torsional or eccentrically applied forces. Aside from this, the strength of a structure as a whole does not depend upon individual members in it, but upon the united effect of all its members combined, so that it becomes a positive waste of material to connect members to each other in an inferior manner. For this reason deep girders cannot be used to advantage with cast-iron columns. Used with built-steel columns deep girders should be connected by rivets the full depth of the web, as in Fig. 8, and not as in Fig. 9. The open holes show positions of the field rivets.

FIG 6

In reviewing an experience of several years in designing new structures and examining old ones, it can be said that the more experience one has the less likely he is to lay down any hard and fast rules of procedure. The conditions affecting each case are so various that construction which might be safely used in one case would be totally unsuitable in another case, while to the inexperienced eye the same two cases might have every appearance of similarity. The indiscriminate use of manufacturers' tables by those whose knowledge of the subject stops there often leads to incongruous, not to say harmful, results in practise. It reminds one of the young dressmaker who started out by attempting to fit all her customers with the same pattern. Tables and formulæ are exceedingly useful when rightly understood and applied, but a thorough acquaintance with their limitations in actual practise, as well as the power to know good from bad practise, is a necessary preliminary to their intelligent application.

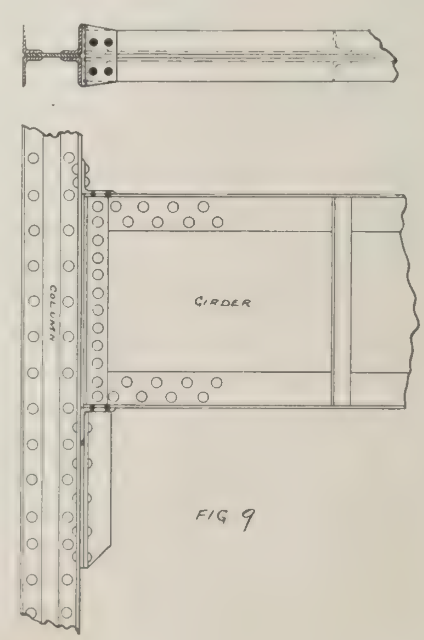


FIG 9

THERE can be no doubt that the best windows for brick churches are either those beautiful Italian developments of plate tracery in which all the bricks are carefully cut and rubbed for their proper place, or those in which, within an enclosing arch of line upon line of brickwork, a small portion of stone is used for the traceries.—*Street.*

Architectural Terra-Cotta.

BY THOMAS CUSACK.

(*Continued.*)

THE building now before us (Fig. 39) will be found to coincide in many things with the one chosen as the subject of last example, besides the construction of its cornice, of which more anon. This similarity is sufficiently marked to suggest comparison, which, if made, must reveal some of the points of divergence. But first, as to the resemblance. The two buildings were designed and erected simultaneously; granite being used in the lower stories of both, with gray terra-cotta and brick for what may be considered the shaft of the building. The last story and the main cornice are, in each case, entirely of terra-cotta, no face brick being used above the lintels of the story below. They were, we presume, planned to meet the greatest number of known wants, with the least sacrifice of space, and, in other respects, carried out in accordance with approved practise, the best classical authorities available having been consulted and followed (perhaps too literally) in determining their respective styles of exterior detail. At this point they begin to part company. They are by different architects, belong to different cities, and have nothing in common as to origin or ownership. The former building is fifteen stories, and standing on a corner, has one frontage on a side street, and the other on a thoroughfare more widely known than any other on the American continent. The remaining sides abut on adjoining property to about one third of that height, above which they are frankly exposed as rear walls, pending a similar upward movement on the sites now occupied by these dwarfed, diminutive relics of a bygone time. The latter, standing free from encroachments on all sides, afforded what we can well imagine to have been an eagerly accepted opportunity for harmonious treatment on four elevations. Here was a chance for the erection of an architectural entity, prized, we presume, in proportion to its exceeding rarity in the business center of most cities. The opportunity, in this case, has not been wasted. For, if "design, order, and congruity" be the essentials of good architecture, we have them embodied to a degree that is both creditable and encouraging. The fortunate architects were Mr. James Windrim and his son, John T. Windrim, of Philadelphia. The building virtually belongs to that city, being part of the Girard estate, of which Mr. Joseph L. Caven is chairman of committee, and to whose enterprise the success of this project is said to be largely due.

More closely examined, the fundamental difference will be found to consist in the adoption of the Ionic order as the prevailing keynote, in preference to the Doric of last example. This has been done subject, of course, to such modifications as become expedient in applying either of them to a thirteen-story building. Avoiding, so far as is possible, anything in the nature of an invidious comparison, we think this is unquestionably the more manageable of the two orders; and of that the building now under notice affords a particularly happy illustration. The freedom with which it has been handled by Mr. Windrim, without incongruity, is not merely an evidence of care and deliberation; it shows that he had a comprehensive grasp of his onerous undertaking as a whole and from the outset. There are few, if any, indications of his having taken hold inconsiderately of an unknown quantity, for in no case (to use an inelegant but very expressive phrase) has the tail been able to wag the dog. If there be an exception to this throughout the building, it is probably confined to the columns at the thirteenth story. There is nothing to be said against the use of these columns *per se;* on the contrary, much might be urged in their favor, but, considering their distance from the average spectator, a certain exaggeration with the view to greater boldness of detail would have been quite justifiable. If "'twill be recorded for a precedent," then so much the better in all such cases, provided it is done with judgment and discretion. The persuasive Portia, with an artist's eye to a still more effective climax, did not deign to "alter a decree established"; yet, with due deference to the strict laws of Venice, whereof she was adjudged a well-deserving pillar, there are times and places (of which this is an instance) where the eye is the ultimate arbiter, when one may say with Bassanio: "To do a great right, do a little wrong." Columns of the same general proportions are used in the vestibule, etc., in which positions they are unexceptionable. But in those placed at a height of 160 ft. from the street level, we think the number of flutes might have been reduced to, say eighteen, allowing a proportionate increase in the size of flute and fillet. For the same reason the finer lines in capital could have been omitted, and its projection, especially that of the abacus, increased with obvious advantage. As it is, the striation in the columns is not sufficiently perceptible, and the capitals appear rather meager, therefore the general effect less satisfying to the eye than could have been desired in this otherwise spirited composition.

FIG. 39. GIRARD BUILDING, PHILADELPHIA, PA.
James Windrim & Son, Architects.

To be sure, this, like other tall buildings, is bound to be viewed from a variety of points other than the one already mentioned. This much we gladly admit in extenuation of the foregoing criticism. An ever-increasing population is destined to spend most of its waking moments at various levels in surrounding buildings of corresponding height. From these points much of the detail will be seen under more favorable conditions. It may likewise be fairly conceded that no stage setting has been invented that will suit all parts of the house. With that understanding, a compromise is made between the parquet and the dress circle; less regard being had to the supposedly less critical "family circle," and no attempt

The construction of balconies at the tenth story is withheld for subsequent discussion, in connection with others of a like character.—T. C.

made (in this one particular) to "split the ears of the groundlings," ye gods of the gallery. So, too, in another branch of the arts — painting; whether in the works of old or, shall we say, new masters, they are seen best from an approximately correct focus; adjusted instinctively to the vision of the individual spectator. But after all, in the case of buildings — it may be from force of habit coeval with the human species, amounting to a pre-"sky-scraper" prejudice — most of us are inclined to fix our judgment seat at some coign of vantage on the opposite sidewalk. Of the future we must speak with reserve; but from this point of view the buildings of the present, like those of the past, will be criticized, commended, or condemned. It may be noted in this connection that the well-known optical illusion which makes a high building with parallel sides appear top heavy has not been ignored or forgotten in this one, where the remedy is simple, and the result undoubtedly effectual. At the fifth story, and again at every second story up to the eleventh, the wall line recedes three quarters of an inch, or 3 ins. in all, making a total difference of 6 ins. each way in the plan area of the building, at bottom and top respectively. Practically as well as æsthetically considered, it will be admitted that this gradual batter is equally beneficial in all high buildings; and if anybody is in search of a precedent, Mr. Windrim has furnished one here that is not likely to be assailed.

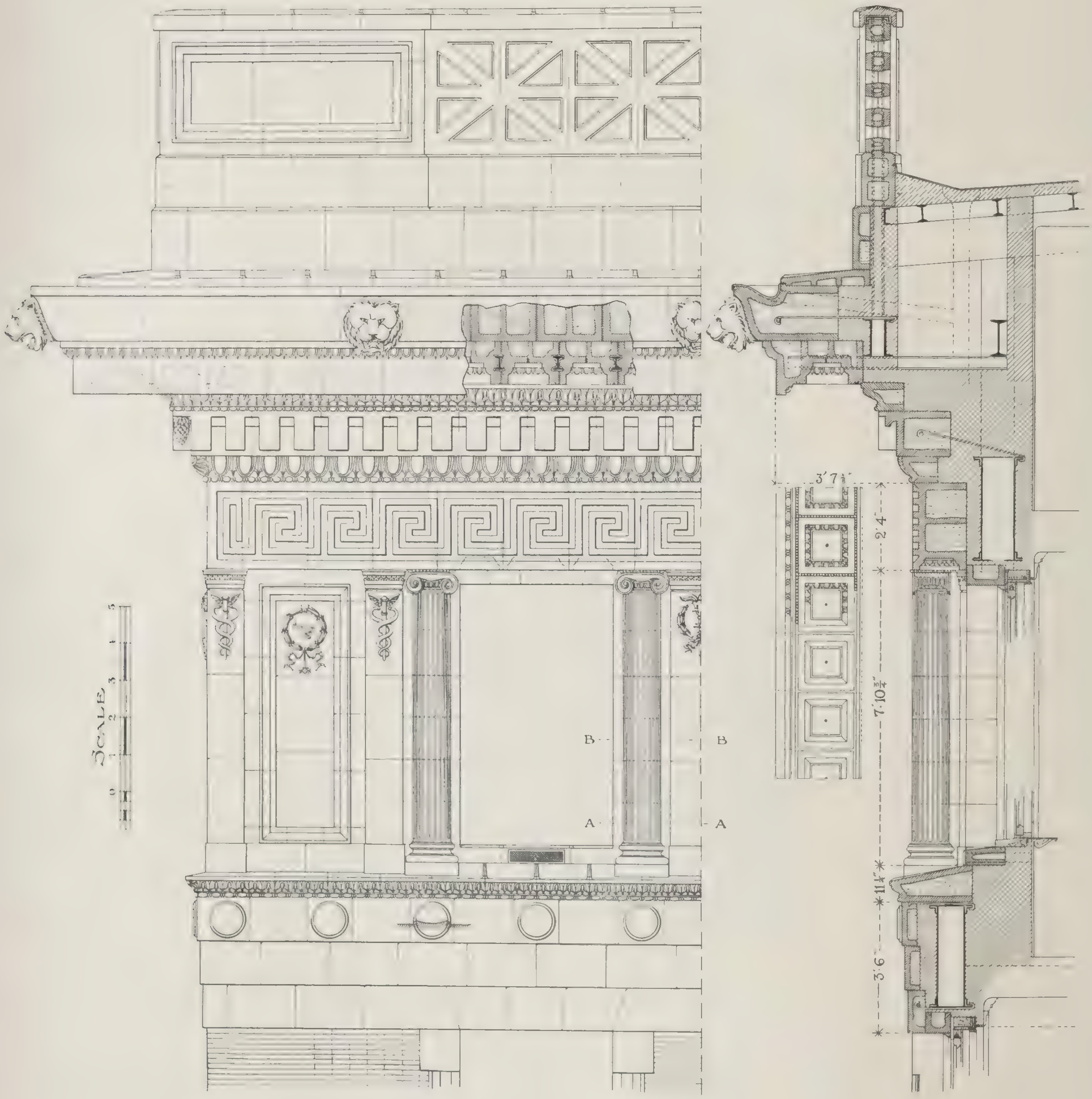


FIG. 40.

A true section through thirteenth story, the cornice and parapet above, with part elevation of same, is shown at Fig. 40 as executed. At Fig. 41 are plans through one of the piers showing their construction, from which it will be seen that all the blocks are made to alternate; breaking bond at every course, except at back of square shaft, in which provision is made for cramping it to the adjoining block; which, in turn, is locked in position at each suc-

ceeding course. In addition to this, the brick backing is built into the chambers of the blocks and around the main column; an example of well-knit composite construction, the strength and reliability of which it is impossible to gainsay. No misplaced effort this, in a building bearing the name of Stephen Girard, whose biography was among the school books of the present writer. It is not unworthy, in point of strength and tenacity, the business methods of the old sea captain, from whose magnificent bequest this building is but an offshoot — albeit, we think, an enduring one.

The fret course forming frieze is jointed vertically throughout, to save cutting through the pattern diagonally. This is on the face only, however, and to a depth of about 3 ins. in the blocks spanning apertures below, in which case the joints are radial to the remainder of their depth; thus forming an arch-lintel. This principle of construction we have from the Greeks, and yet we are often asked to believe that they had no knowledge of an arch! while their more enterprising successors are given all the credit of that invention.

The cornice has a total projection of 5 ft. 6 ins. from wall line to tip of lion's head; and is carried by 4 in. 12 lb. I beams, spaced on 1 ft. 7 in. centers. These cantilevers might have been farther

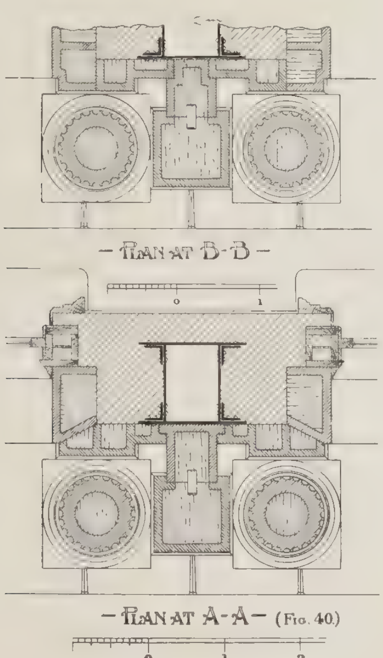


FIG. 41.

apart, but their position is determined arbitrarily by the arrangement of paneling in the soffit; which, for reasons to be explained presently, had to be uniform in size, and, as nearly as possible, rectangular. The vertical joint, as it approaches the lower surface, is deflected from center of rail just enough to avoid cutting through the row of buttons at that point. In other respects, the method of inserting the I beams and of setting the blocks themselves does not differ materially from those described in last example. To such as have noted what there was to say in that connection, it will not be needful to add much on this occasion. Those who have not done so cannot do better than accept our invitation in this regard, and refer back to last issue of this journal. If it serves no other purpose, it will at least spare us the weariness of a twice-told tale.

The two 12 in. channels seen directly under the superincumbent parapet are well placed. They equalize the weight resting on them and distribute it over the cantilevers below, and they, being securely bracketed to a 12 in. I beam running between main columns, require no better fulcrum than the solid brick and terra-cotta on which they rest. The size of these channels may be in excess of actual requirements; but as to that, we defer to the opinion of the capable engineer who fixed the weight of section to be used; if a fault, it is on the side of safety. The pierced parapet is made in single blocks, as shown, with a series of stanchions passing up between them; to these is secured a continuous channel, into which the blocks are molded to fit snugly between the flanges. The top coping is then bedded down in cement, securing the iron from atmospheric action; *minus* exposed tie-rods and stays, which, even on a roof, can hardly be divested of an unpleasant suggestiveness. Do what we may, they seem to shape themselves into alphabet from which we involuntarily spell out — "hold me up until I get paid for"; then come disturbing visions of sheet metal, followed by symptoms of *mal de mer*.

In the panels of the cornice soffit, to which allusion has been made, there is a fanciful device for artificial lighting, which, if not unique, is an evidence of progressive thought and resource. Instead of the usual rosette, an incandescent bulb is inserted in the center of each panel, which, like Goldsmith's bedstead, is "contrived a double debt to pay." This row of pendants marks the place of a conventional ornament from the rising until the going down of the sun. When old Sol has disappeared for the day, away to the west of Fairmount Park, the building will become outlined by a fringe of luminous jets, from which its detail may be studied under a subdued light; for, in truth, a fixed planetary system of its own will begin to twinkle, as is the custom of stars of greater magnitude in the milky way. If modern invention has robbed life of half its poetry, it has brought compensating enjoyments within the reach of all, since the founder of Girard College went aloft for the last time in 1831. Thus does science pay tribute to art, — to the fine as well as to the industrial arts, — for in architecture, rightly understood, and at its best, we have a blending of both.

SHATTERED SURFACES ON BRICKS.

FOR many years architects have been puzzled to account for the "blistering" so frequently found on otherwise sound bricks. It commences by the development of minute cracks on the surface, radiating from a central point, and the center gradually becomes lifted up so as to form a shallow miniature cone. Eventually this may drop off, leaving a scar on the surface, and rendering the whole unsightly. This phenomenon has generally been ascribed to chemical action, and for working out the problem it has been assumed that the center of the disturbance is a piece of lime (burnt chalk, for instance), which, by slaking, expands and produces the cracks alluded to. Of course, there can be no question that lime is often guilty in cracking bricks; but we feel certain that in the case of the blistering above referred to, lime is not the culprit. For you may examine as many of these shattered surfaces as you like, and you will find that the phenomenon is as clearly pronounced in those bricks which do not contain lime lumps as in those which do. Others have suggested that the scaling is due to the accumulation of moisture behind the skin, or real surface of the brick, and they have suggested that the damp course should be improved, and there is much in that contention. At the same time it is undeniable that shattered surfaces are seen under such conditions that the damp course could not be held responsible, and it frequently happens that out of several square yards of brickwork, only a dozen or so of the bricks are affected in the manner now indicated. The writer is under the impression that much of this scarring is due to unequal contraction and expansion in heterogeneous bricks, and it shows that the brick earth has not been thoroughly pugged in the first place. Even a cursory examination shows that these low-grade bricks are full of hard pellets, and these would expand and contract at different rates to the comparatively looser material. A cone would tend to form over these pellets at the point of least resistance — and that would be at the surface — in much the same way as a sheet of lead becomes corrugated when used as sink lining, owing to the alternate application of hot and cold water.— *The British Brickbuilder.*

The Art of Building among the Romans.

Translated from the French of Auguste Choisy by Arthur J. Dillon.

PART III.

CHAPTER II.

THE ART OF BUILDING AND THE ORGANIZATION OF THE WORKING CLASSES.

(Continued.)

THE servile condition of the corporations was the consequence of an evidently vicious economic system; but to the credit of the Roman law makers, it must be said that they always endeavored to keep this dependence within the limits made necessary by their political system; and the same principle that led them to respect municipal franchises kept them from all useless interference in the interior management of the workingmen's corporations. This is shown even in the decemviral laws. The law of the XII. Tables says, "Power is given to corporations to organize themselves in any manner they please, provided they do not infringe the public law."[1] And it was by virtue of this broad tolerance that the workingmen were enabled to establish separate associations among themselves, to place themselves under the direction or financial responsibility of some more enterprising or wealthy workman who could interpose between them and the State, dealing, usually under bond, with the magistrates who were charged with the duty of erecting public buildings, and playing the rôle of an actual contractor (redemptor or locator operis).[2]

Moreover, there was unconsciously formed an administration in each corporation entirely distinct from the general administration of the city.[3]

The Senate reserved the right of authorizing or suspending the meetings of the corporations; but, once authorized, the corporation had an existence of its own independently of that of the city of which it was a part; it made its own special police regulations, some of which have come down to us; and it created in itself a series of officers whose functions and mutual subordination seem copied from the organization of the Roman city. Far more than the city, the corporations were the ties that united the Roman workingmen, and their lives were so concentrated about them that they came to date the years, even in public acts, from the time of the foundation of their special corporation.

Just as the municipalities, the corporations were divided into centuries and decuries, under chiefs ordinarily elective, known as masters, quinquennials, etc.; the members placed themselves collectively under patrons and took honorary associates; they met on certain days in meeting places, which are designated scholæ in the inscriptions; and there they celebrated feasts from which religion was rarely missing. They had their priests, their temples, and a complete system of religious institutions that persisted even until after the triumph of Christianity, and called down on such corporations that still retained the pagan tinge all the rigor of the laws of the emperors who succeeded Constantine.[4] Besides the religious and administrative divisions, there was another division, founded on the nature of the occupations followed by the members of the same college. The corporations were divided into distinct classes of workingmen, whose sharply separated prerogatives marked the extreme division that existed in industrial operations. As far as concerns the collegium structorum, or corporation of workingmen who had charge of Roman masonry, I have not been able to find with any certainty the names of the categories whose existence I have indicated; this college left no traces except in short inscriptions, and it is to be hoped that new discoveries will supply us with the documents that are still lacking in its history. But if we judge from the corporation of aquarii whose details are given by Frontinus, the division of labor was marked in the organization of the corporations by very distinct categories. But whether this division coincided with that into centuries and decuries is a question on which the documents so far seem to throw no light.

Frontinus (de Aquæd., 177) divides the corporation of aquarii into villici, castellarii, circitores, silicarii, tectores, etc. I will not stop here to discuss the meaning of these distinctions, which would lead me far from my subject, but will only note their multiplicity and call attention to the deductions that can be drawn therefrom. The aquarii, it is true, constituted a familia publica and not a corporation properly so called, but the distinction between corporations and

[1] Digest., Lib. XLVII., tit. XXII., l. 4. Cf. Dig., Lib. III., tit. IV., l. 1; Lamprid., Alex. Sev., Cap. XXXIII.

[2] The attributes of contractors are fixed by the Digest, Lib. L., tit. X., l. 2, § 1. For evidence that the bargains with the contractors were usually made under bond, see Cic., in Verrem, Act II., Lib. 1, Cap. 54-56. Cf. the Lex puteolona, p. 144, etc. The same custom is brought out in the account of a difficulty that arose between Q. Cicero and his contractor (Cic. ep. ad Q. Frat., Lib. III., ep. 1, § 5). See also Cic., ad Attic., Lib. IV., ep. XVI., § 14; and finally, the numerous conventional inscriptions, such as "Opus ex . . . HS faciendum locare," everywhere the "locatore" or "redemptor" seems to undertake the responsibility of executing the work at his own risk, in return for a round sum. Ex.: Orell. 3148; 3277; 3325; 4616; 6605; 6609; 7420 a θ, a κ, a λ; 1476 (with the correction of M. Henzen), etc. (On the customary bargains of this nature among the Greeks, see Rangabé, Ant. hell., 771; Corp. inscrip. gr., 2266).

[3] Below is a table of the most important texts in support of this account of the internal organization of the corporations, and of safeguards opposed to them by the central administration;

1st. Intervention of the government into the internal affairs of the corporations.

The right retained by the Senate to forbid the meetings of the workingman's corporations,

Digest, Lib. III., tit. IV., l. 1; Lib. XLVII., tit. XXII., l. 3:
Orelli. 2797, 3140, 4075, 4115, 4235 . . .

Corporations where the number of members was limited by the government,
Plin. Epist., Lib. X., ep. 42.

2d. Existence and examples of an internal police freely accepted by the corporations,
Digest, Lib. XLVII., tit. XXII., l. 4.
Orelli, 2417, 6086.

3d. Division into centuries and decuries.
Orelli, 4060, 4071, 4085, 4137.

4th. Hierarchy and magistracy of the corporations,
Ordo collegii. Orelli, 2417, 4115.
Magistri, Orelli, 4054. . . . 4137.
Quinquennales, Orelli, 4054. . . . 4137.
Plebs. Orelli, 4054. . . . 4137.
Offices whose hierarchical order is distinctly shown.
Actor or Syndicus, Digest, Lib. III., tit. IV., l. 1.
Præfectus, Orelli, 7198.
Quæstores. Orelli. 2863.
Curatores, Orelli, 7194.
Scribæ, Orelli, 1687.

Honorary titles,
Pater collegii. Orelli, 4134.
Patronus collegii, Orelli, 4054. . . . 4137.
Immunis collegii, Orelli, 4137.

5th. Election in the nomination of certain officers of the corporations,
Orelli, 4057.
Reservations in favor of the government,
Orelli, 2163.

6th. Religious organization of the corporations,
Priest of the corporation, Orelli, 4094, 7213.
Temple, Orelli, 4133.
Special divinities, Orelli, 1710, 1711, 4122.
Funerals, Orelli, 4107.
Banquets, Orelli, 6086.

7th. Slavery in the corporations,
Cic., in Pisonem, Cap. IV.
Digest, Lib. XLVII., tit. XXII., l. 3, § 2; Lib. XXIX., tit. II., l. 25. § 1.
Orelli, 7214, 2886, and particularly inscrip. No. 6086 where slaves are put on a footing of equality with freemen.
Names of freedmen, Orelli, 3019,

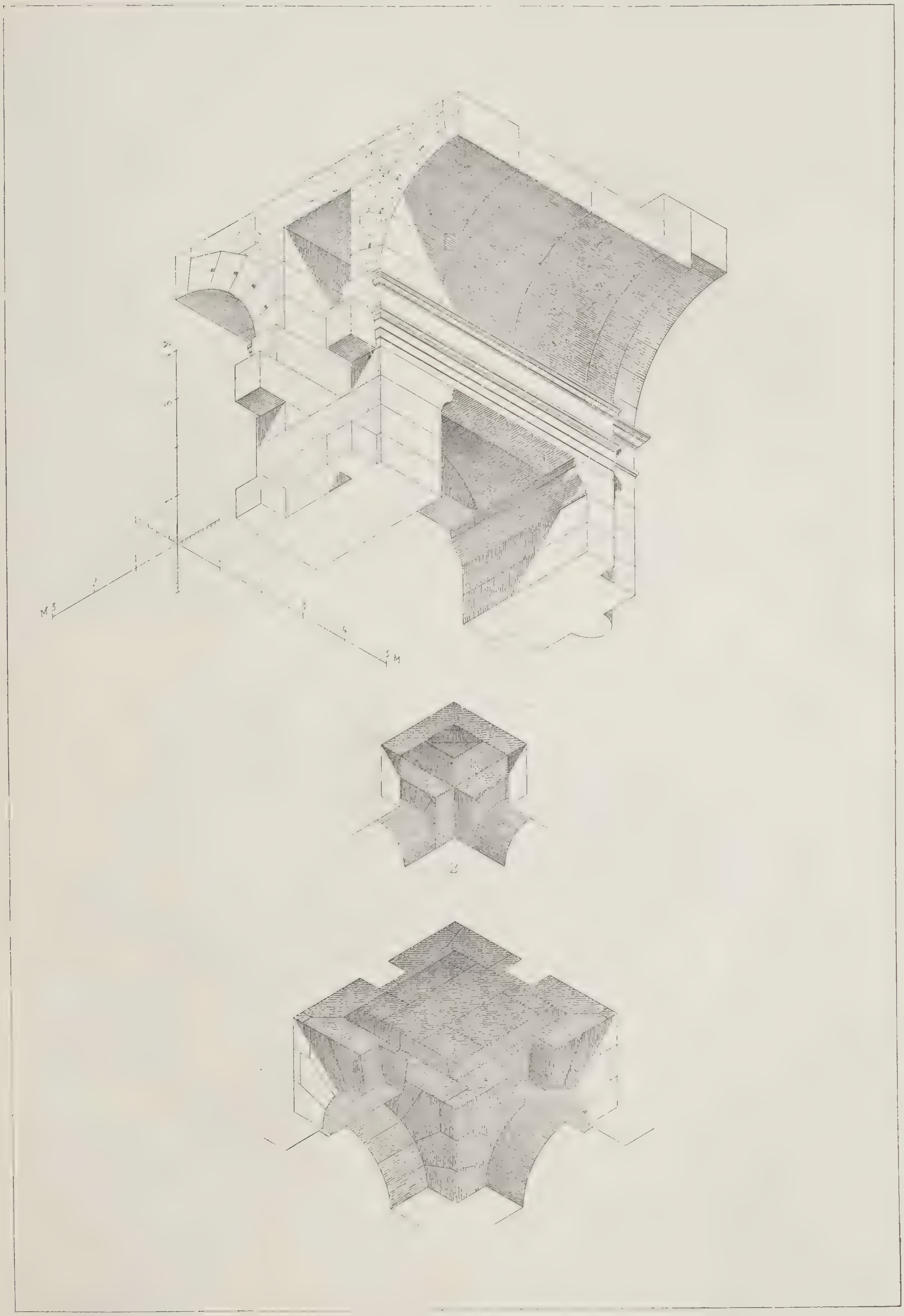
8th. Civil rights of the corporations,
Rights of proprietorship, Digest, Lib. X., tit. IV., l. 7, § 3.

Colleges forbidden, at least in principle, to receive legacies,
Cod. Justin, Lib. VI., tit. XXIV., l. 8.

Exceptions to the rule,
Orelli, 4080; Murat., 516, I.

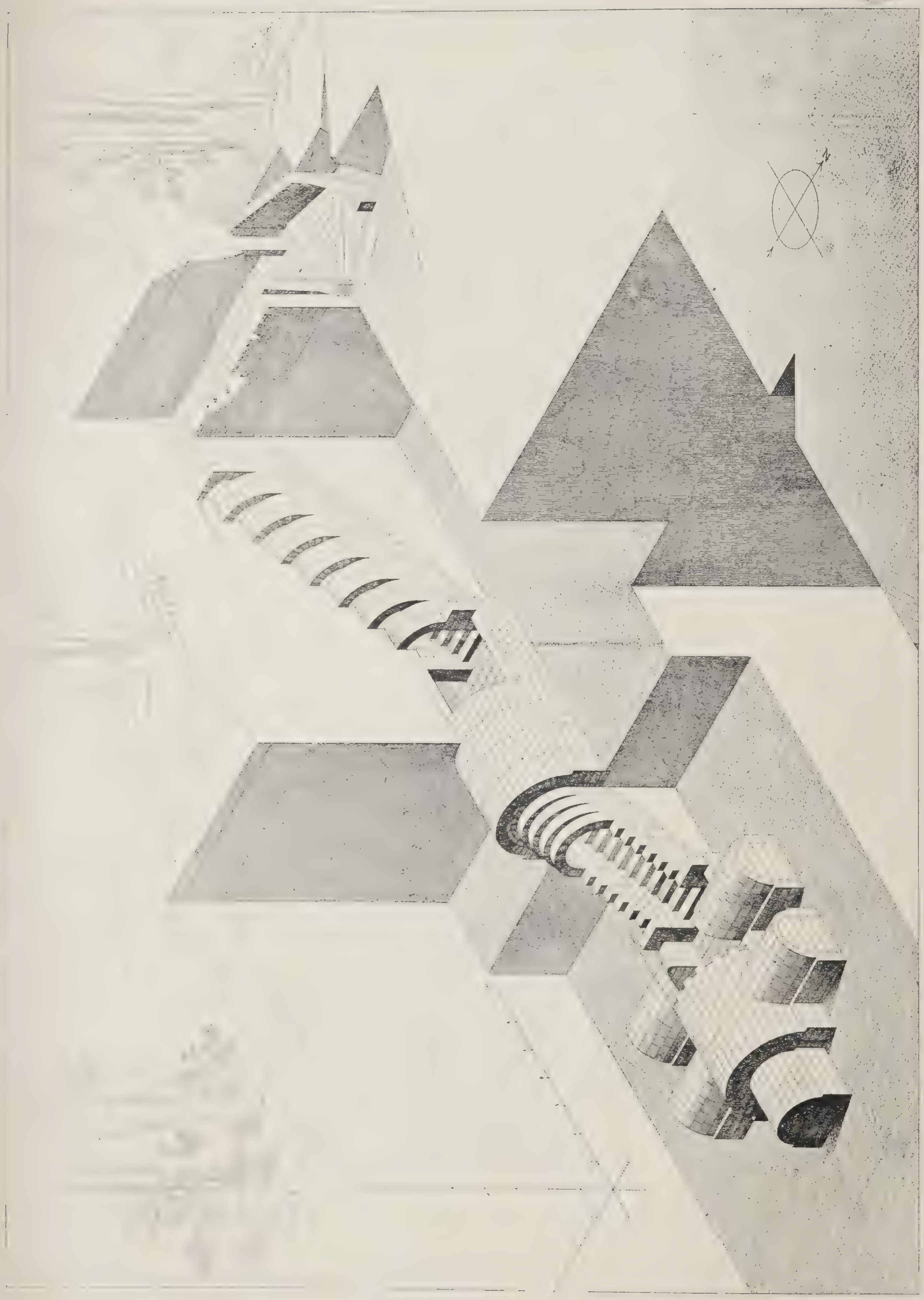
9th. Various details,
Common treasury, Orelli, 1702, Digest, Lib. III., tit. IV., Lib. I.
Special chronology, Orelli, 1702, 820, 3891, 4064.
Meeting places (Scholæ), Orelli, 4088 . . . .
Seals of certain corporations, Orelli, 2395.

[4] It was for such cause that the Emperor Honorius made a law against the dendrophori and the centonarii which excluded them from Roman society (Cod. Theod., Lib. XVI., tit. X., l. 20).



ARLES (Upper Figure). ST. REMY (Middle Figure). VIENNE (Lower Figure).

PLATE XVII. THE ART OF BUILDING AMONG THE ROMANS.



FORET DE RETZ.

PLATE XVIII. THE ART OF BUILDING AMONG THE ROMANS.

the familæ publicæ seemed to consist in the exclusively servile condition of the members of the latter body. Moreover, the reasons for the division into classes were the same in both cases, and the most evident conclusions lead to the supposition that it existed in the corporations just the same as in the familia publica that is the best known to us.

Is it even necessary to have recourse to the analogy? The wide division of functions is written, as might be said, in the structure of the edifices. I will take up an example previously cited, the Coliseum (Plate XXII). We saw that each part of this gigantic building constituted a separate piece of construction; that there were special work-yards and different workmen for the body of the walls and the pilasters that terminate them; that a pier of squared stone, placed in the rough rubble of brickwork, was built by other workmen from those that laid the filling of the walls. Sometimes the work of the mason and that of the stone-setter were conceived in contrary views; the concrete vaults of Provence, compared with the vaults of cut stone, furnish an example of this queer contradiction of principles. Moreover, the sharp distinction made by the Romans between the structure and the decoration is significant; it evidently corresponds to a clearly marked separation between the classes of artisans who erected the buildings and those who ornamented them; perhaps a place must be given to the rivalries that are brought about by such a system of brotherhoods, and we may see that even the paltry jealousies of the workmen of the empire, the least details of their history, are marked in the works they bequeathed us.

The custom of placing the contractors under bond had also marked results, so that it is possible to distinguish to-day between the works executed by contract and those built directly by the State through its own agents.

Frontinus insists on this distinction (de Aquæd., 119) and a single example is sufficient to make it clear. We spoke of the amphitheater of Verona, and cited the incorrectness of details; among others, the flat arches, where the stones, scarcely squared up, show everywhere negligence or mistakes; this is an edifice built by the State by means of irresponsible labor; perhaps it was done by corvees, but it is certain that the amphitheater of Verona was not the work of a contractor bound, in return for an agreed sum, to the strict application of the rules of his art. Certainly it was not by contracts that the Greeks obtained those perfect works whose ruins we still admire; that method was sufficient for the building of the walls of the Pireus, but in building the Pandrosium, the State dealt directly with each of the workmen it wished to employ on its works.[1] The Romans followed, for their purely utilitarian constructions, the same course as the Greeks took in building the walls of the Pireus; they simply made one of those contracts of which the celebrated contract of Pouzzoli is the type.[2] The building was minutely described, but the methods to be followed were left to the device of the contractor. The construction was entirely under his care, and he only could profit by any improvements he should make in it,— an important point, for it explains the reason of the personal interest which resulted in the introduction of the many ingenious artifices that were employed to render the auxiliary work simpler or more economical.

But a detail that was more closely connected with the organization of the corporations had a still stronger and more distinct influence on the future of Roman construction; this was the regulations that fixed the methods of the art of building in every corporation, and that consecrated, it might be said, all the lessons of the past. The corporations were not satisfied in following the regulations of order and discipline; aside from the articles that treated of the policing of the associations, the lex collegii comprised technical prescriptions similar to the statutes that forbade members of our ancient guilds following vicious methods, or that rendered certain traditional methods obligatory. These ordinances were retained in the corporations and, doubtless, were never made entirely public; so that it is easier to establish their existence than to determine their details. Those that are the best known belong to the corporation of fullones. Pliny gives them entire, and adds that they were submitted to the sanction of the people and voted as laws of the State. Evidently this was not an isolated case; and limiting ourselves to our special subject, it is quite reasonable to admit that there were regulations relative to construction when we see that the Romans fixed the treatment of woven goods by law; furthermore, it is known through evidence in Frontinus that a law fixed the seasons when works in masonry could be carried on, and the season when they should be suspended because they could not be executed with success (Front., de Aquæd., 123).[3]

On the whole, these corporations resemble the institutions of the middle ages by a remarkable conformity of institutions and customs; and, if it were allowable to neglect the part occupied by slavery in the ancient corporations, one might say that the ones were the likeness and continuation of the others.

The corporations had under their orders — and sometimes included among their members — a large number of slaves; and there is no doubt that the cooperation of this class, whom the ancients spared but little, aided greatly in making the rude methods of Roman construction possible. But the distinction that separated slaves from freemen in the corporations must not be exaggerated; there were, perhaps, some reasons to make this distinction sharp in the corporations of builders, but in the other corporations they were not so great. By a privilege that one would little expect to find in ancient society, slaves, or foreigners, affiliated to the corporations seem often to have been put on an equal footing with freemen or Roman citizens; and on reading some of the regulations of the corporations that have been preserved in inscriptions, one is astonished by the perfect equality that seems to have existed here between the two classes, elsewhere so profoundly separated.[4]

[1] See Rangabé, Ant. hell., inscrip. No. 771, for the walls of the Pireus, and inscrip. Nos. 56 to 60 for the Pandrosium.

[2] Orell., 6428.

[3] This regulation contained three principal parts:

1st. To commence masonry not sooner than April 1.

2d. To suspend operations during the great heat of summer, in order to avoid the sudden drying of mortar.

3d. To finish work before November 1.

The last article calls for a comparison which I think quite useful. By a remarkable coincidence it is this same date of the first of November that is indicated in the Lex puteolana before cited (Corps. inscrip. No. 577), as the date when the work should be completed. It is perhaps a fortuitous coincidence, but it seems natural to explain it by attributing a common origin to the two documents, which would then be distinct enunciations of the same custom to which Frontinus alludes, recommending it "as an excellent practise, though seldom observed in spite of the law that prescribes it."

I do not know whether we should place in the same series the extract from the leges operum, given by Pliny (Hist. nat. XXXVI., 55), which forbids contractors from using lime less than three months old; these leges operum — the Lex puteolana is an example of them — seemed to have less the character of general laws than of special agreements in particular cases.

For the regulation in form of a law imposed on the collegium fullonum see Pliny, Hist. Nat., XXXV., 57.

[4] To complete this article a list of the principal corporations that were occupied in public works is necessary, which is the object of this note.

1st. We have first the Collegium structorum. This corporation was composed exclusively of men working on rubble masonry (struere, structura is never applied to works of cut stone without mortar) The Colleg. structorum is mentioned in the following inscriptions: —

Gruter, p. 106, 8; 646, 6; 1002, 1; 1117, 10 (?); Orelli, No. 6354: this inscrip. is noticeable in that it establishes the incorporation of slaves in the Colleg. structorum.

Spon. Miscell. ant., p. 231. This inscrip. seems to indicate a special category of structoris parietarii in the Colleg. structorum. The Digest also seems to distinguish the arcuarii who constructed vaults from the structoris (Lib. I., tit. VI., l. 6).

Privileges: The structores were included in the list of 32 professions that were exempted from all public charges, and particularly from the corvee by a law of Constantine (Cod. Theod., Lib. XIII., tit. IV., l. 2).

2d. With the Colleg structorum there may be cited a series of clearly distinct corporations, comprising the workmen occupied in preparing blocks of dressed stone to be used without mortar. With the structores they enjoyed the complete exemption given by the constitution of Constantine. Their names were Lapidarii, Maffei, Mus. Veron., 130, 1: Orelli, 4208, 4220; Marmorarii, Orelli, 4219, 4220, 7245; Quadratarii; Godefroy, Cod. Theod., commentary on the text cited.

3d. The group of corporations which we assemble because they are almost invariably associated in the texts, the fabri ferrarii, tignarii, centonarii, dendrophori:

(a) The fabri ferrarii, or simply fabri, worked in metal used in building.

(b) The tignarii worked in wood, included in the list of exempts (Cod. Theod., Lib. XIII., tit. IV., l. 2) and to which were attached either as subdivisions or as allied trades certain secondary professions, of which a list will be interesting because it gives a measure of the division of labor of which we have so often spoken.

The Clavarii materiarum (Orelli 4164), whose special duty was to prepare the dowels

The institution of corporations as shown by this summary review seems to carry as a consequence these general facts : —

1st. It should have assured the regular execution of public works, but, in return, to have lent itself but little to changes and innovations. It is the fate of all systems, where detailed regulations are interposed between the agents and the object, to lead quickly to formulas, to consecrated types, which may be excellent but which are unchangeable. This happened to Roman construction. The moment of its taking form was a time of a general overturning of ancient institutions, but the period of formation was brief and suddenly the methods became fixed ; and, as we have already had occasion to say, they remained invariable for nearly four centuries, from the reign of Augustus to the time of the final removal of the seat of the empire.

2d. Corporations such as these, whose membership is hereditary, who govern themselves, and whose territorial limits are more or less narrow, will quickly develop differences in their manner of working that will distinguish them from each other. Two corporations bearing the same name, in different municipalities are really entirely separate and distinct and have each its own traditions ; so that, in surveying the system of the working classes of antiquity, it is less astonishing to find some differences of detail in the methods used in different cities than it is to find, in all these methods, a certain uniformity that extends from one end of the empire to the other.[1]

used in assemblages. The Sectores materiarum (Orelli, 4278), who sawed the timber. The Lignarii (Orelli, 4265); and finally, the Fabri intestinarii (Orelli, 4182), who did the lighter woodwork for the interior of buildings.

(*c*) The two last professions that were part of this group were the dendrophori and the centonarii, of whom little is known.

The dendrophori can be taken either as those employed in taking care of the forests, or else in hoisting the timbers used in the scaffoldings. There are two opinions as to the functions of the centonarii ; one of them holds that they made coarse clothing (vestarius centonarus ; Orelli, 4296) from fragments of cloth, or else the thick covers which were used, according to Vegecus (Lib. IV., Cap XVII.), to prevent the combustion of engines of war. The other opinion, however, recoiling from the idea of associating a corporation of tailors with those of the smiths, foresters, etc., takes it that the centonarii were simply roofers whose work of tiles or of shingles had more or less the aspect of that "cento" or patchwork whose name was given to the corporation. (See for the two interpretations, Rabanais, Recherches sur les dendrophores ; Serigny, Droit public et adminis. romain, t. II., p. 336 ; Wallon, Hist. of slavery, etc.)

Perhaps the word which in Greek corresponds to the centonarius of Latin will help to settle the question. There is found in the MS. of the *ἑρμηνεύματα* of J. Pollux, which was discovered by M. Boucherie, to whose kind favor I owe my knowledge of it, (*κεντρωνοράφος*) centronarius (sic). This translation seems a conclusion in favor of the first hypothesis.

However that may be, it is easy to perceive the reason that led the Romans to group together the four principal professions we have just cited. The ancient authors speak of a corporation formed to guard against fires, though the inscrip. make no explicit mention of this corporation. Pliny (Epist., Lib X., ep. 42 and 43) proposes to Trajan the creation of a colleg. fablorum for this object, and how could this corporation be better recruited than from the smiths, the carpenters, the navvies, and from the centonarii, whether these last were roofers or makers of the "centos" that protected the engines of war from fire? May this not be the origin of the grouping together of all these artisans and the explanation of their privileges? Sometimes the dolabrarii and the scalarii were joined with the centonarii, which would seem to furnish a further argument in favor of our opinion, which has, furthermore, the support of the authority of Heineccius (de Orig. et juve coll. et corp.).

4th. We will recall, in terminating this list of the corporations, those we have designated as calcis coctores, who prepared the lime for public works, and the vecturarii and navicularii, who did the transporting.

Above, and probably outside of these corporations, we find the heads who directed the public works, of whom the principal ones were : —

The curator operis (Orelli, 24, 1506, 2273, 3264, 3265, 3382, 4011), who had the general direction of the works, and who, once they were accepted (opere probato) took on himself the entire responsibility ; it was with the curator alone that the State had any dealings. (Dig. Lib. L., tit. X. l. 2, § 1.)

The contractor (redemptor, or locator operis) of whom we have previously spoken ; it seems, from the Digest, where his duties are fixed, that his functions were those of a subordinate to the curator. "The curator is responsible to the State, the redemptor to the curator."

The mensor ædificiorum (Orelli, 3223) ; the name of the profession and the instruments for measuring engraved on the tomb of one who followed this profession are the only indications we have of its duties.

The architect, the technical overseer — who did not, however, always correspond to the architect of to-day, for the ancients, and particularly the Greeks, sometimes gave the name of architect to the contractor (Bockh : Die Staats-haushaltung der Athener, Liv. II. Cap. X. and XIII.).

Finally, at the other end of the scale, far below the ordinary conditions of the corporations of artisans, was all the class of men who provided the material for public works, and who were placed by a closer dependence on the State in a condition but little better than slavery, the metallarii (Cod. Theod., Lib. X., tit. XIX.). These not only worked in the mines, but, with the convicts, quarried the stone to be used in construction. (See constit No. 8, etc., of the tit. cited.)

[1] I have previously endeavored to state exactly the degree of uniformity that is to be found in Roman art, as well as the importance of the local deviations.

This uniformity, which, in spite of the shades of difference, dominated the whole system, came from the influence of the examples of Rome ; and furthermore, from the control exercised over the works executed by the corporations of the provinces by the agent appointed by the central administration. The emperors gave to the constructions of the municipalities a curator whose functions were more or less well defined according to the period, but who seems to us to represent, to personify, the intervention of the emperors in the provincial works. Nothing leads us to believe that each work of public utility had a curator thus appointed by the emperor ; but at least a large number of undertakings were directed in this manner, and it is most probable that this control on the part of the central power was not without influence in establishing common methods in the different provinces. This was particularly true about the time of Hadrian.[2]

Later the curator tended to lose his character as an agent of the emperor, to assume that of a municipal magistrate ; and, finally, towards the last days of the empire, his office became one of those overpowering dignities that were imposed on the rich inhabitants of the cities, from which an exemption was considered as a special benefaction of a munificent prince.

Apart from this general direction given to the great works, there was another influence that tended to establish uniformity of methods throughout the empire ; this was the participation of the legions in works of public utility. The Roman troops were regularly employed in building, and either alone or with the corporations of workingmen worked on the municipal monuments. Vegecias insists on the organization of a certain corps with this view : "The legion," says he, "includes carpenters, masons, wagon-makers, painters, etc.," and a law allowed the employment of these soldiers on public works, only forbidding their employment in private constructions. Another portion of the law authorized the proconsuls, in case of necessity, to place the troops at the service of the curator operum for the construction of temples and other public buildings. "Ministeria quoque militaria, si opus fuerit, ad curatores adjuvandos publicis dare."[3]

As for the application, the epigraphic texts not only show us the legions assisting in the erection of public buildings, but also represent them as being occupied in quarrying the stone or making the bricks to be used in provincial works. On every page of the collection of the inscriptions of the Rhine are to be found marks of bricks that recall the corps that made them. Sometimes only the number of the legion or of the vexillatio is placed on them ; sometimes one can read on them even the names of the workmen (figuli) or of chiefs of the military workmen (magistri figulorum) who prepared them.[4]

[2] It will be recalled that Hadrian had the first idea of registering the artisans of the empire. It was he who appointed the curators to the baths of Venusia and of Benevento (Orelli, 3263, 3264); and it was he who imposed the quinquennials on certain building corporations (Orelli, 2163). No ruler seems to have mixed himself up in the details of construction in the provinces as much as this emperor-architect.

[3] Organization of the legion in view of works of construction.

Veget., Lib. II., Cap. XI.

Prohibition against placing soldiers under the orders of private contractors. Digest. Lib. XLIX., tit. XIV., l. 12, § 1.

Troops put under the orders of the curators operum pub. by the proconsuls. Digest, Lib. I., tit. XVI., l. 7, § 1.

In this case the cost of supporting the troops was placed on the province for whose profit they worked. This fact is known from a sentence of Philo (adv. Flacc., p. 966), where the author shows us the system by citing the abuses to which it gave rise. It is also indicated in some inscriptions that can be found in the résumé of the Corps. Inscrip. græcorum, Vol. III., p. 314 (Inscrip. Ægupt ., Introd.).

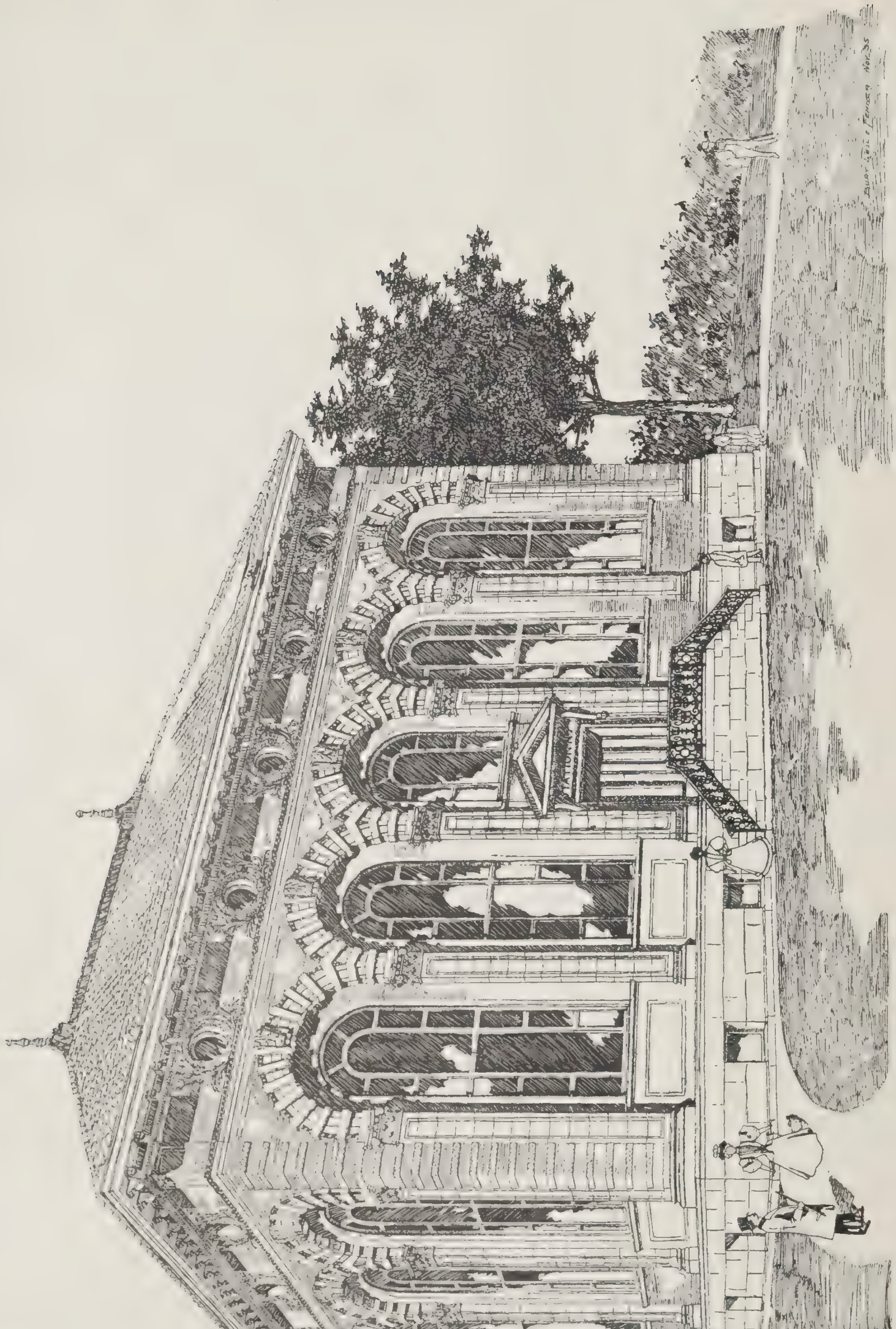
[4] I owe all these indications to M. Fr. Ritschl, who kindly pointed out, among the documents of his collection of Inscriptions of the Rhine, the following :—

1st. Stone quarrying by the legions ;
Corpus Inscrip. Rhen. No. 651 et seq.

2d. Brickmaking by the legions ;
Corpus. Inscrip. Rhen. No. 223, p. 63, i, 2.
Mention of the vexillationi who aided in the brickmaking.
Corpus. Inscript. Rhen., p. 118, d. 3.
Names of figuli and magistri figulorum, belonging to the army.
See the list drawn up by M. Brambach ; Corpus. Inscrip. Rhenan., p. 380.

3d. M. Ritschl thinks that the Inscrip. of the Corpus Inscrip. Rhen. under the number 1397, and the three inscrip. 837, 1548, 1554, are relative to the works executed by the troops.

COLONIAL DOORWAY, HARRISBURG, PA.



WATER POWER HOUSE, INDIANAPOLIS, IND.
KIMBALL & THOMPSON, ARCHITECTS.

Fire-proofing Department.

FIRE-PROOFING UNDER FIRE-PROOFING LAWS.

THE ideal condition of architecture and structural practise would be one which is in the hands of competent, trained architects and builders, who so thoroughly understand their business, and whose integrity is so above question that municipal regulations would not be needed for their direction and control, but each problem as it arose would be solved in the best manner for the particular case, and intelligent preconceived judgment would take the place of the arbitary and often irrational laws which, because of our human limitations, are necessarily imposed upon the practise and the theory of building. Laws which, of themselves, may in a general sense be commendable, are not always applicable, and there are crudities and even absurdities in all of our municipal regulations which, so far from attaining the object sought, — namely, a production of the best kind of work,— often through the ignorance of the law makers, if not through the carelessness of the executives, will produce a directly opposite result. This is especially true, we are sorry to say, in regard to the specific statutes which are intended to regulate, define, and limit the use of the so-called fire-proof construction.

Every architect and builder knows what first class fire-proof construction is. We all admit that iron is absolutely worthless for structural purposes unless perfectly protected against intense heat. We theoretically know and practically admit that very few mediums are efficient to properly protect the steel; and while a number of materials have been tried with varying success, the choice is limited within very narrow bounds. We make experiments which determine just how far much material can be trusted; we know just what should be done for theoretical cases; and yet in probably every large building which is put up in our principal cities there are weak points in the construction, or more properly in the fire-proofing, which the law allows and even sanctions in some cases, and yet which no one, if put to the direct question, would for a moment claim to be efficient or even intelligent. One reason for this arises from the workings of the contract system. The architect is expected to decide in advance every detail of the construction, and no individual architect has yet arisen who is sufficiently all-knowing to include everything. Then, in estimating, the builders are obliged to figure as closely as they can. The builder cuts prices with the fire-proofing contractors, the iron worker cuts with the fire-proofer, the general contractor cuts with the whole of them, and the owner keeps up with the procession by crowding down the general contractor. Then when the building by any chance is caught in a serious conflagration and is partially or totally destroyed, we say that another fire-proof building is gone wrong, and we hold up our hands in structural horror at the blindness of such and such architect, or such and such builder, to permit such scant fire-proofing, when, perhaps, in the very next building we will do just as badly ourselves. We are too inclined at the present period to consider cost before efficiency. The fire-proofing is hid away from view. After it is neatly plastered over no one can tell what is inside; the odds we assume are one hundred to one that the building will never be burned down, and we take our chances, fortunately, with a very large degree of impunity. In these days of the wide dissemination of knowledge through books of all sorts there is no excuse for any architect or builder being ignorant of proper methods, and the practical theories of fire-proofing as applied to large buildings, but we unfortunately encourage cheapness rather than excellence. Too many of our architects will bank their reputation on the stability of an important structure upon the remote chance of the building catching fire, and will not be particular enough to insist upon the very best for that part of the work which is never seen, is little appreciated, and is often not understood at all by the man who pays the bills. There is altogether too much chance entering into much of our fire-proofing. In these pages we have repeatedly emphasized the value of burnt clay as a fire-resisting medium. We cannot afford to take very many chances when so much is at stake, and when we know a material will resist a high degree of heat it behooves us to be very cautious in tolerating anything else.

Any one who has passed by a building in process of erection cannot have failed to be struck with one or two weak points which seem to be neglected. One very frequent lapse of this kind is in the so-called fire proofing of external steel beams and columns. According to the laws of the city of Boston, which, by the way, are much less exigent than those of some other cities, one inch of ordinary plaster is accepted as sufficient protection for any structural steel work. We will not undertake to discuss the fire-resisting qualities of an inch of plaster; but the so-called inch becomes in many cases barely one sixteenth as actually applied, and we have repeatedly noticed instances where a coarse mesh of iron wire will be stretched over an iron beam and a rough coat of plastering applied thereto, the plastering being so thin and crowded so closely against the iron that every mesh of the netting is visible in the finished plaster. And yet this passes as a fire-proofing of the iron beam, when, as a matter of fact, it is doubtful if a beam so protected would last five minutes in an ordinary conflagration.

We know of one instance in a city not more than a thousand miles from Boston where the theory of fire-proofing was carried to even a more absurd extent. A certain manufacturing company desired to build an iron truss over its engine room. The statute in this particular city distinctly stated that all structural metal work must be protected in specific ways; but in another part of the building law there was a clause which recognized the value of so-called fire-proof paint, and by virtue of this latter ambiguous clause the builder was allowed to simply paint the ironwork of the girders with one of the whitewashes which passes for fire-proof paint, and the work was then accepted and passed by the local inspector as being thoroughly fire-proof. This is, of course, an extreme case; and yet in buildings of the first magnitude and importance we have seen steel columns intended to support loads running as high as six and seven hundred tons, which were protected only by a thin enclosure of expanded metal and Windsor cement, which formed both the fire-proofing and the finished plaster work, and was so scanty in places that a lead pencil was inadvertently punched through the wall and through the fire-proofing. When the building was finally inspected it was found that the enclosure ran only to the floors, and on account of some furring on the ceiling below there was ample chance for a draft of fire being carried up in the construction of the column itself in such manner as to convert the angles of the column into what might easily become a blast furnace.

The fact is, that notwithstanding the many substitutes which have been devised and advocated on the score of economy, there has nothing yet been found on the whole so satisfactory, so efficient, and so stable in its preserving qualities as terra-cotta. Not terra-cotta one half an inch thick, run out in thin slabs and deeply grooved at that, and then stuck up against an iron column with a little plaster of Paris, but a good, generous envelope of burnt clay, thick enough to act as a real insulator, solid enough to bear considerable jarring, and secured in place so strongly that the force of a jet of water from a steam hose will not dislodge it and break down the protection. We imagine that nine owners out of ten, if asked whether they could spare the space equal to four or five inches on the outside of all the flanges of isolated steel columns in the first story of a building would anxiously say no, that the space was too valuable, and that fire-proofing must be devised which would not take up so much valuable space. But it is the province of the intelligent architect and builder to decide these questions, not on the score of economy *per se*, nor of renting space alone, but to make his fire-proofing, like Cæsar's wife, beyond suspicion. The lesson of the Pittsburgh fire is that it is perfectly possible to protect steel in a most efficient manner, and we cannot afford to take possible chances when it is so easy to make sure. An investor, a real estate owner, will very naturally economize in the construction in the hidden parts of a building to almost any extent

to which an architect will let him, sometimes this economy resulting from ignorance, but quite as often from deliberate intent to take advantage of a law which is framed in ignorance and allows only too many loopholes for inefficient construction. But we believe that every one would be better satisfied in the long run if our architects and builders would take the stand that they would not for one moment countenance experiments in fire-proof construction except when the experiments are conducted simply for their own sake; that in a large modern building the fire-proofing above all things must be of the best; and fire-proof paint, a light skimming of plaster or a thin furred plaster wall around the column, while having a purpose and perfectly proper under some conditions, are totally inadequate as a fire resistant. The best is none too good. We have never been able to reach perfection in this most uncertain of the applied building sciences, and the architect or builder who lends himself to the employment of anything than that which he knows is going to stand the most severe tests is imperiling his own reputation, is preparing the way for a possible catastrophe, the evil results of which can hardly be measured, and though he may be acting for the seeming benefit of his economical client, he is really doing just the reverse. In construction the architect must take the ground that he knows more than the investor, that he himself is the arbitrator of what shall be done, and he should make it his rule always to give his client what he really wants rather than merely what he thinks he wants. And, beyond this, our laws relating to fire proofing should be rigidly revised by those who know more about the subject than the average lawyer or legislator.

We have sometimes had a Utopian dream, which at the very outset is admittedly impracticable, and yet which is fascinating by its simplicity, and that is to abolish off hand all building ordinances which relate to the use of materials, strength, protection, etc., and instead of spreading the shield of the law over doubtful interpretations and questionable local practises, to put the whole responsibility for the success or failure of every building, where by right it belongs, on the shoulders of the architect, holding him to the strictest accountability, and compelling him by severe penalties to build in accordance with what in ninety-nine cases out of one hundred he knows is right. Unfortunately, so long as architecture is an open profession, such a condition of affairs is impossible, and we can only hope that the repeated severe lessons, which we have at times presented to us, may be the means of a surer appreciation and a more thorough application of the fundamental principles of fire-proof construction. We cannot afford to continue to send up millions in smoke, when a small percentage of those same millions, if judiciously expended, would make our buildings impregnable.

FIRE-PROOF CONSTRUCTION.

ONE probable result of the increased duty upon lumber will be to increase the number of buildings put up of absolutely fire-proof construction. With this form of building material on the free list, the gradual reduction in the cost of steel beams, terra-cotta, tiles, bricks, and other non-combustible materials has been sufficient to make the cost of an ordinary building hardly more than 10 per cent. greater, if of fire-proof construction, than if put up in the old-fashioned way. But if lumber of all kinds is to have its price increased, as seems probable, by these tariff changes, then it is not unlikely that even this difference will be reduced, so that it may, in a short time more, become absolutely cheaper for a person putting up a brick or stone building to have the interior built in an absolutely fire-proof manner, than it will to have this same interior constructed of wood. As to the duration and to the cost of repairs, the advantages are all on the side of fire-proof construction, while the added space obtained is of itself almost enough to justify the change. In the matter of speed of construction, recent experience has shown that a modern fire-proof building can ordinarily be put up in about two thirds the time required to construct one of the old-fashioned type.— *Boston Herald.*

Mortar and Concrete.

LIME, HYDRAULIC CEMENT, MORTAR, AND CONCRETE. VII.

BY CLIFFORD RICHARDSON.

THE ROSENDALE CEMENT INDUSTRY.

TREATMENT OF BURNED STONE.

THE burned stone, as drawn from the kilns, is carefully sorted in order to reject any partially fused clinker or underburned portions. In a carefully conducted works there is but little of such material, yet always enough to require careful attention. It should, of course, be rejected because of the injury it would do to the quality of the ground cement, but it is probably oftener thrown out on account of the difficulty of grinding it, because it is so much harder, whether over or underburned, than the properly burned stone. With some rock, free from magnesia, the overburned material is ground by itself and sold as natural Portland cement.

Depending on the character of the original limestone, the burned stone may go immediately from the kiln to the mill for grinding; or if it yields a fiery and too quick setting cement, as many of the limestones free from magnesia do, it must either be sprinkled or steamed to make the cement slower setting. The object is to slake the excess of free lime, which would, in the course of making a mortar of the ground cement, raise the temperature so much as to cause a too rapid set. This result can also be accomplished by air slaking the ground cement, but such a proceeding requires very considerable storage facilities and much time. It is, therefore, more expeditiously brought about by treatment of the burned stone before grinding.

For sprinkling a water-pot is used, and a measured quantity of water is carefully dirtributed over the lumps of burned stone as it comes from the kiln. The amount necessary for different stones must be learned from experience. It is usually from one to two gallons for each ton of the burnt material.

For steaming, the burned stone is dumped into a hopper, or bin, with shelving sides, where it is exposed to the vapor from steam which enters at the bottom. Such a bin may have a capacity of from 2,500 to 3,000 barrels of cement. The burned rock after a suitable time is drawn off and treated like that which has been sprinkled.

On reaching the mill it is crushed coarsely in any of the ordinary forms of rock crusher, or with a spalling hammer. It then goes to one of the many forms of crackers, or pot mills, where it is reduced to the size of peas, or finer. At this point it may be screened or sent to the buhrs, or mills, direct. The former process results in a much increased capacity for grinding. The fine powder, which is removed, amounts to about 25 per cent. of the stone, and is, of course, conducted to the receiver containing the ground cement from the mills, and again carefully mixed with it by means of worms. The coarser stone, or the entire run of the crushers, goes to the grinding apparatus, which commonly consists of buhr stones in their many forms. Although they need frequent redressing, every two or three days, stone mills have been found more economical for grinding such a soft material as burned limestone, than any of the forms of mill used for Portland cement. One run of stone, depending on its size and the degree to which the grinding is carried, will take care of from 200 to 150 barrels of cement per day of ten hours.

It is now customary to grind much finer than several years ago, so that as much as 94 per cent. of a high-grade cement will pass a sieve of 100 meshes to the lineal inch. The increased cost is found to be fully repaid in the improvement in quality of the product.

The best Rosendale brands now sift as fine as, residue on 200 mesh sieve, 10 per cent.; on 100 mesh, 6 per cent.; on 50 mesh, 2 per cent.; but ordinary natural cements average 15 per cent. on the 100 mesh sieve.

From the mill the ground cement generally goes to a large warehouse or bin, being thoroughly mixed on the way, so that there shall be no segregation of the harder and softer or coarser and finer particles. From storage it is drawn off by special apparatus and packed in either barrels, coopered near at hand, or in bags. The cement is compacted in the barrels by a shaking machine, or jig. The amount is carefully weighed to 300 lbs. in Ulster County, N. Y., and on the Potomac, but in the West it frequently falls as low as 260 lbs., owing to the smaller volume weight of the Western cements. When properly labeled with brand and date of packing it is ready for the market.

PHYSICAL PROPERTIES AND CHEMICAL COMPOSITION OF NATURAL CEMENTS.

Color. The numerous natural cements of the United States differ in appearance very decidedly, varying in color from the very pale and light buff of the magnesian Potomac and some Western cements, through a gray color, resembling Portland, to the dark brown of the Rosendale brands. The color is due to the oxides of iron, manganese, etc., and the varying proportions and forms in which they are present. The value of the material as a hydraulic cement is not, however, at all affected by its color.

Specific Gravity. The specific gravity of natural cement varies with the rock from which it is made; the denser the rock, the denser the cement. Some well-known brands have the following specific gravities: —

Brand.	Rock.	Cement.
Rosendale	2.84	3.04
Round Top . . .	2.73	2.84
Minnesota	2.74	2.81
Fort Scott, Kans. .	2.72	2.79
Utica, Ill.	2.67	2.70

These specific gravities are, however, for freshly burned cement. If cement has been exposed for some time and absorbed water and carbonic acid its specific gravity becomes much less, falling in one case from 2.84 to 2.57 after a year.

Weight. The volume weight, or density of a natural cement may be roundly expressed as 1.28, water being unity, when packed as ordinarily found in the East in barrels of 3.75 cu. ft. capacity and 300 lbs. weight. A cubic foot in this condition weighs 80 lbs., and a struck bushel 100 lbs. With cements not so dense 300 lbs. may require a barrel of considerably larger capacity and the volume weight be considerably less. When very coarsely ground all cements will, of course, weigh more per given volume than when fine.

COMPOSITION AND PROPERTIES OF NATURAL HYDRAULIC CEMENTS.

From what has been already said of the variation in the composition of the hydraulic limestones in different localities, and even in the same quarries, it is evident that great difference in the composition of the resulting cements and in their properties must exist as well, and that there is no such uniformity in their composition as is the case with Portland cement. That this is so appears from analyses, which are given in the following table, of most of the well-known brands of natural cements, as they are found in the market.

	Lime. CaO	Magnesia. MgO	Silica Comb. SiO_2	Alumina. Al_2O_3	Iron Oxide. Fe_2O_3	Soda. Na_2O	Potash. K_2O	Sulphuric Acid. SO_3	Loss on ignition. $CO_2 + H_2O$	Silicates undec.
ROSENDALE.										
Hoffman, 1897	34.64	14.82	16.49	10.96	4.68	.55	1.25	1.04	4.50	12.42
Hoffman, 1890	35.84	14.02	18.38	15.20				.93	3.73	11.46
Hudson River	36.67	14.35	18.17	11.30				1.32	4.27	13.11
New York & Bridge	33.18	19.61	11.28	9.40					4.40	14.64
Newark & Rosendale	34.14	19.61	24.43	8.68		.23	1.39		3.57	6.35
Rock Lock	35.35	14.75	14.82	17.50				1.41	4.68	12.18
NEW YORK—WESTERN.										
Akron Obelisk	37.54	26.14	13.94	10.02		.52	1.60		4.58	6.81
Star	41.60	22.24	16.20	4.40	2.80	.23	1.39	2.06	6.90	4.00
Buffalo	39.20	26.52	13.24	4.40	2.00	.41	1.44	1.39	6.80	3.24
PENNSYLVANIA.										
Siegfried	45.95	11.53	5.78	6.86				.69	26.17	13.83
Milroy	41.90	29.73	13.56	5.00				.74	6.40	4.68
WESTERN.										
Sellersburg, Ind. Anchor.	38.28	11.94	18.52	4.78	3.24			1.97	10.39	6 24
Milwaukee	33.40	22.60	13.80	4.00	2.80	1.64	.87	2.59	9.50	11.20
Louisville	46.64	12.00	20.42	4.76	3.40			2.57	6.75	3.74
Utica, Ill.	29.99	19.79	9.58	2.76	2.16	.26	1.51	1.35	15.96	17.42
KANSAS.										
Ft. Scott	49.80	12.16	17.60	4.00	5.00			2.04	4.50	4.20
MINNESOTA.										
Mankato	45.51	15.02	16.30	3.34	3.80	1.33	.70	1.94	10.00	5.06
POTOMAC.										
Shepardstown	34.83	11.33	22.89	9.36			1.25	1.49	5.13	13.62
Antietam	29.38	13.37	14.54	10.44	3.25			1.15	7.15	18.96
LIME CEMENTS.										
Round Top	45.66	2.86	21.68	8.34	4.14			1.31	8.13	7.96
Cumberland & Potomac	39.54	3.80	20.42	8.38	5.38				10.20	9.80
Cumberland	41.96	3.19	20.25	14.76					7.97	9.41

Among these cements the following extremes of composition are to be seen: —

	Total Lime and Magnesia.	Lime.	Magnesia.	Silica combined.	Alumina.	Iron Oxide.	Soda.	Potash.	Sulphuric Acid.	Loss on ignition.	Silicates undec.
Highest	65.84	49.80	29.73	24.43	10.44	5.08	1.64	1.60	2.59	26.17	17.42
Lowest	42.75	29.38	2.86	5.78	4.92		.23	.87	.93	4.20	3 24

The differences are very great. If, however, the inferior brands are excluded and only those considered which are standard, such as Hoffman Rosendale, Milwaukee, Louisville, Round Top, and Fort Scott, the following figures are obtained: —

	Total Silica and Magnesia.	Lime.	Magnesia.	Silica combined.	Alumina.	Iron Oxide.	Sulphuric Acid	Loss on ignition.	Sand.
Highest	61.96	49.80	22.60	21.68	15.20		2.59	9.50	11.46
Lowest	48.52	33.40	2.86	13.80	4.00	2.80	.93	3.73	3.74

Among these standard brands there is still, however, a great diversity of composition, and each seems to be more or less a type in itself.

The results of these differences in composition, of course, affect the hydraulic value and other physical properties of the cements.

THE USE OF WET SAND IN THE MAKING OF MORTARS.[1]

BY P. HERVIEU.

THE influence of the degree of dryness of sand upon the setting of mortars is well known; it suffices to say that, without having any very serious effect upon lime or slow-setting cements, wet sand can, with rapid-setting cements, retard the setting by inducing the formation of aluminate of lime. Otherwise, the resistance of mortars does not appear to be diminished, to judge from the experiments of Candlot.

More or less water in the sand used has another consequence, equally well known, but which has not received the attention that it merits; *i. e.*, the difference of volume which exists between dry and wet sand.

The following table gives the results of experiments made by Candlot.

Kind of Sand.	Weight of 1 Liter of Sand Measured without Packing. Dry.	Wet.	Loss of weight due to humidity.	Observations.
	Grams.	Grams.	Grams.	
Rounded Quartz Grains.	1418	1170	248	Average sand: grains pass through No. 20 screen (19 meshes to an inch), and remain upon No. 30 (28 meshes per inch).
Angular Quartz Grains.	1300 1560	1019 1148	281 412	Mixture of six sizes of sand passing through screens No. 50, 30, 20, 12, 6, and 2.

[1] Translated from *Nouvelles Annales de la Construction*, August, 1897.

This is for average sand; it increases to 300 grams for very fine sand, and descends to 25 grams for large particles; the maximum was attained with a mixture of different sizes.

These diminutions in weight are naturally accompanied by a proportional increase in volume; thus, in the examples in the table, the volume of wet sand increased $\frac{1}{212}$th, $\frac{1}{276}$th, and $\frac{1}{359}$th, of that of the dry sand; inversely, the dry sand is 0.825, 0.784, and 0.736 of the volume of wet sand.

These results have been confirmed by experiments which we have made and which it is easy to repeat:

1. A liter of river sand thrown upon a platform in the ordinary condition of wetness, exposed to the sun, was reduced, after apparently completely drying, to 0.782 liter.

2. A liter of the same sand, dried upon a heated iron plate, was reduced to 0.761 liter.

These figures approach quite closely to those of Candlot.

Variations in volume increase for the same sand with the degree of wetness up to a certain limit only; in fact, it diminishes when the sand is soaked and disappears when the sand is entirely immersed.

We will not attempt to explain these facts, as such discussions will be found in all works on the subject, but we will show the effects by an example.

Suppose a cement mortar is to be made composed of 300 kg. per cubic meter (500 lbs. of Portland cement per cubic yard of sand) mixed in a box graduated to secure this proportion (generally it is more convenient to mix half this quantity of mortar). The volume of dry sand will be exactly 1 cu. yd. and the proportions exact; with wet sand the real volume will not be more, but by reason of the moisture there will be less dry sand, making the relative proportion of Portland cement 394 instead of 300 kg. per cubic meter (650 instead of 500 lbs. per cubic yard of sand). It will hence be necessary to take 500 × 0.782 = 390 lbs. of cement to add to the wet sand, a difference of 650 — 500 = 150 lbs., which at 64 cents per 100 lbs. (price at Paris) corresponds to an extra expense of 96 cents per box of mortar. Lime and cement can be readily weighed before mixing, but it is inconvenient to weigh the proportions of sand.

On the other hand, river sand, which is more frequently used, is often brought directly by boats from where the dredge had taken it; it is hence very wet when placed in the mortar boxes, and to obviate this by artificial drying is not to be thought of.

It is a question as to whether dry or wet sand should be considered as the type. It is doubtful whether dry sand alone can be considered as such.

The proportions adopted in each case for mortars is fixed by the results of tests made on small specimens. To compare these tests in order to arrive at definite conclusions, it is necessary to use material not only identical in nature, but in the same physical condition also at the time when it is used; that is to say, the sand should not be taken for this purpose as it comes, but should be dried in such a manner as to render the samples as nearly uniform as possible, in order to be able to evaluate their influence correctly in the finished briquette.

Then a mixture of 500 lbs. of cement to 1 cu. yd. of dry sand would be considered as the normal, and it would simply remain to find what proportion of wet sand should be used. The most simple method of doing this is to shake up the sand measure in such a manner that the wet sand will be of the same volume as dry sand; this cannot be done exactly, but the difference will be small. One liter of sand, the same as was used in the preceding experiments, has been brought by shaking to 0.808 liters, exceeding sun-dried sand by 0.018 liters. But such shaking up or settling is not possible on all public work, and the measuring devices are not adapted to it. It has, however, been thought well to call the attention of engineers to this fact in order to prevent serious mistakes in proportioning mixtures. No rule could be made which would be universally applicable, but each one must use his own judgment and experimental data. If it is important that a definite mixture should be specified, it is equally so that methods be employed to carry out the specifications rigidly.

PRODUCTION OF HYDRAULIC CEMENT IN 1896 IN THE UNITED STATES.

THE reports upon the production of Portland and natural cements in the United States in 1896, by Spencer B. Newberry and Uriah Cummings, for the Annual Report of the Director of the Geological Survey for 1896–97, Part V., Mineral Resources of the United States, have been recently made public, and contain much information in regard to our cement supply that is of interest.

The production of American Portland cement reached 1,543,023 bbls., in 1896, as compared with 990,324 in 1895, an increase of nearly 56 per cent. over the previous year. This increase was most marked in the Lehigh Valley region, the largest producing center in the country, where five plants yielded 1,048,154 bbls., or 68.1 per cent. of our entire supply, as compared to 485,329 bbls., or 61.2 per cent., from the same source in 1894. New York and Ohio were the only other localities where a steady and considerable growth occurred, the remainder of the country showing a decline.

The imports of Portland cement were 2,989,597 bbls. in 1896, which is a slight decrease over those of 1895, but the amount imported annually during the past six years has been very uniform. Over 40 per cent. of the imported cement was German, the proportion having gradually increased, with a diminution in the amount received from Great Britain, owing to the increased appreciation of the character of the German cements, and the more careful methods employed in the German factories, the English manufacturers clinging, until very recently, to the old methods, and being, in consequence, not up to modern requirements.

The imports of Belgian cement were equal to those of English brands, but their character was inferior. They consist largely of so-called natural Portland cements made by burning, at the temperatures usually employed for the production of Portland cement, a natural hydraulic limestone which approximates the composition requisite for a high-grade Portland cement.

The production of Portland cement in the United States was, in 1896, 34.7 per cent. of our entire consumption, where it was only 13.2 per cent. in 1891, and 25.3 per cent. in 1895, so that, while the importations have not increased, the factories of this country have tripled their output. The prospects of the industry, therefore, seem to be good, especially as the high character of the best brands is recognized. The price of American Portland is, however, much below that of the imported article, with the duty included, owing to the sharp competition among the leading manufacturers, so that a difference of price at from 30 to 50 cents per barrel between the two may occur.

By far the largest amount of American Portland cement is made from limestone, eighteen factories using this substance as compared to eight which use marl, while the use of rotary furnaces, instead of vertical kilns, is also increasing relatively.

Attention may also be called to the fact that our markets, probably in response to a demand for cheap cements, is filled at the present time with very inferior second and third grade material, which is called Portland cement, and which consists of either overburned natural cement rock, improperly burned cement clinker, or some mixture, such as a good Portland cement intimately ground with a large proportion of sand or limestone, which, while in itself perfectly suitable for use under certain conditions, should not be sold as Portland cement and at a price which is relatively much too high.

The production of natural cement increased slightly in 1896, accompanied by a very slight rise in value. The total output is stated to be 7,970,450 bbls., of which Ulster County, N. Y., produced 3,426,692; New York State, 4,181,918; and Indiana and Kentucky, 1,636,000; while the output in pounds *per capita* of our population was 33.93 as compared to 13.04 in 1880. For much masonry, which was formerly laid with lime, natural cement is now used.

Attention is called by Mr. Cummings to the differences in the standard of weight in a barrel of natural cement in the East and West, in the former case 300 lbs. constituting a barrel, and in the latter 265 being considered one.

The Masons' Department.

SOME REASONS FOR ARBITRATION.

CONSIDERING the fact that almost every building contract contains a clause providing that, in case of difference of opinion regarding the value of extra work or work omitted the matter shall be settled by arbitration, it seems rather strange that we hear so comparatively seldom of disputes of this kind being adjusted in such a way. In discussing the difficulties attending the accurate valuation of work attention has been called to the fact that it is almost impossible for an architect to do better than approximate the cost of labor and materials, and the results which he obtains, it must be admitted, are often unreliable and inaccurate. What the architect wishes to determine in cases of dispute over the value of work is what is fair and reasonable, but under existing conditions it seems practically impossible for him to obtain such information, for the simple reason that he cannot get at the bottom facts. The natural conclusion to draw from such conditions is that contractors are unwilling, as a rule, to let an architect know the true value of work and materials, which, in turn, shows one of two things; either that the contractor feels that the architect will misuse such information if he is allowed to have it, or that the contractor, for certain reasons, does not care to have it known where his profit is made. After making all due allowances for the shortcomings of the profession, it can hardly be claimed that the first-named reason is a just and valid one. On the other hand, it is usually admitted by a contractor that his profits are both irregular and uncertain; that is to say, while the totals on a given piece of work may be very close, detailed estimates would show wide variations. While such a state of things exists both architects and contractors must work more or less in the dark so far as their knowledge of the actual value of certain work and material is concerned. The way to have such matters definitely determined is to have a certain number of experts, with opportunities for knowing all the facts of the case, sit down together and, after a discussion of the question, both in general and detail, figure the cost of the work individually, and after a comparison of the different results, agree finally on a certain definite sum as representing as nearly as possible the true value of the work and materials. After a certain number of cases had been settled in this way, they would constitute valuable precedents which could be referred to as a basis for setting a fair price on similar work. It is true that, as no two buildings are alike, the cost of the labor and materials necessary to perform a given piece of work varies also. But with a reliable unit to start from, it is comparatively easy to approximate with a considerable degree of accuracy the value of work which is similar in character to that of which we have a precise and definite knowledge. There seems to be a decided inclination on the part of contractors in this country to keep from the architects the true cost of the various things which enter into the construction of a building. As has already been stated, unless there is reason to believe that the architect will misuse his knowledge of prices, there is really nothing to be gained by keeping him in the dark on matters of this kind; for, without any definite basis upon which to found his opinion, he naturally inclines to under rather than over estimate values, and, of course, the contractor suffers to whatever extent this is done. To show that the architect can be trusted with a knowledge of prices we need only to refer to the English practise, where, before a contract is signed, the builder is required to deposit with the architect a detailed bill of quantities with the prices for each different kind of work and materials stated. Attention has been called to the fact that if contractors could be compelled to depend on what may be called legitimate profits, building contracts would be awarded more fairly than at present; for upon this basis an estimate would include the fair profit to which the builder is justly entitled, and he would not dare to run the risk of taking the work at cost or less, and depending on changes for which he can charge a price wholly out of proportion to the true value of the work.

Unless we can introduce the English method of estimating, which seems for the present impossible, the only way for the architects to learn definitely the value of work and materials is in the line of arbitration. In point of fact it would seem desirable in many ways to have some permanent board of arbitration, under the control of the architects' and builders' associations, whose duty it should be to settle all disputed claims arising between members of either of these bodies.

HOW TO BUILD A CHIMNEY.

THERE are floating through building literature a thousand and one remedies for curing smoky chimneys, but very few methods suggested of "how to build a chimney that will not smoke." This, of course, is a pretty difficult task, particularly if the chimney is placed in a multi-gabled house, or near other buildings, trees, or hills. Yet fairly good results can be obtained by the scientific builder if he follows certain given rules. If a chimney is intended to carry smoke from an open fireplace it is a good plan to make the throat not less than 4 ins. wide and 16 ins. long, which will give an area at that point of 64 ins.,— of course something will depend on the size of grate,— then the flue should be abruptly enlarged so as to nearly double the area, and so continue for a foot or more; then it may be tapered off gradually until the desired area is obtained. The inside of the chimney should be "parged" or plastered throughout its entire length, and made as smooth as a trowel can make it, and the mortar used should be the very best so that it will harden with age. No flue should contain less area than 60 sq. ins. The best shape for a chimney flue is circular, or many sided, as giving less friction. Brick is the best material for the purpose, as it is a non-conductor. The higher above the roof a chimney rises the better. When expense is no object, 8 in. drain tile (glazed), built in the chimney, makes the best flue known, if properly jointed.— *Canadian Architect.*

THE ENGLISH METHOD OF BUILDING CEMENT SIDEWALKS.

EXCAVATE the ground to a depth of about 5 ins. below the finished level, and upon this lay about 1 in. thickness of cinder or gravel; upon this lay a layer of clean, hard stone, or other suitable material, broken so as to pass through a 3 in ring, well watered and rolled, filling up inequalities and leaving the surface about 2 ins. below the level of the footway (sidewalk). Divide into bays (sections about 6 ft. in width, with battens of soft wood), and complete each alternate bay by laying stone foundation carefully prepared concrete composed of one part Portland cement, two parts coarse, clean gravel, or other suitable procurable material, passed through a 1 in. screen, and two parts clean, sharp sand, which must be well beaten or rolled into place; and before it is set a finishing coat 1 in. in thickness of a finer and richer concrete to be added and brought up to the finished surface of the footway, and well troweled and smoothed into place. This finishing coat may be composed of one part Portland cement to two parts granite chippings, three parts gravel, or other suitable material, which will pass through a ¼ in. sieve. As the work is finished the battens may be removed and the joints filled with fine sand.— *Carriage and Footway Construction.*

THE LAW.

WHERE lots have been conveyed subject to a covenant that no buildings shall be erected on the same within a certain distance of the street, such covenant is enforceable, though the streets on which such lots abut has changed from a residence street to a business street.— *Superior Court of New York.*

WHERE a contract for the sale of real estate provides for a variance in the dimensions of the premises of one inch in width and depth, the purchaser will be relieved from the contract if the building on the premises encroaches more than one inch on the adjoining premises.— *Superior Court of New York.*

Recent Brick and Terra-Cotta Work in American Cities, and Manufacturers' Department.

NEW YORK.—Nothing of great importance has occurred during the past month in building and real estate circles, although the aggregate has been important enough to fulfil predictions of a prosperous winter, and places September among the successful months of the year. There appears to be no cessation to the building of homes in the metropolis, as the reports of building enterprises show. There seems to be an endless supply of apartment houses in the city for people of every class, and fortunately the demand is equal to it. After the first of January there may be many radical changes made in the building laws, owing to the new building department, which will have complete charge of the building interests of the greater city, according to the new charter. This event will be awaited with great interest by architects and builders especially, and we can confidently look for great improvements.

Cady, Berg & See, architects, have prepared plans for an interesting building to be used for public baths. The building will be three stories in height, of brick and terra-cotta. It is situated on Rivington Street, and $75,000 is to be expended. This venture will be considerable of an experiment for New York, but promises to be successful if popular interest and public opinion are any criterion. Great credit is due to the *Cosmopolitan*, which drew attention to the subject by a competition several years ago, in which the scholarly designs of Mr. John Galen Howard were placed first.

RESIDENCE, MORRISTOWN, N. J.
Built of mottled brick furnished by the Raritan Hollow and Porous Brick Company, 874 Broadway, New York City.

The most important large work in contemplation is the new home for the Geographical Society of New York, for which purpose a fund of $400,000 is already on hand. The site has not yet been chosen nor plans selected. Judge Charles P. Daly is president of the society, a position which he has held for the past thirty-three years. Its first president was George Bancroft, the eminent historian.

George Crocker, the Californian millionaire, has purchased the old Knickerbocker mansion, corner of Fifth Avenue and 64th Street, at a cost of $250,000. He intends making improvements which will cost as much as the site.

Louis H. Sullivan, architect, has drawn plans for a twelve-story office building to be erected at the corner of Bleecker Street and Broadway. Cost, $400,000.

Edward Wenz, architect, has planned two five-story brick flats to be built on 112th Street, near Lenox Avenue. Cost, $38,000.

R. H. Robertson, architect, has prepared plans for a four-story brick and stone dwelling for Mr. George Sherman, to be erected on 55th Street, near Fifth Avenue, at a cost of $65,000.

John Hauser, architect, has planned four five-story brick flats to be built on Madison Avenue near 101st Street. Cost, $100,000.

Henry Anderson, architect, is making plans for the new Lutheran church on 140th Street, corner Edgecombe Avenue. It will be a brick building, and will cost $60,000.

John Woolley, architect, has planned four five-story brick flats to be built on 67th Street, near Amsterdam Avenue. Cost, $72,000.

W. Ç. Dickerson, architect, has planned four five-story brick flats to be built on 117th Street, near Lenox Avenue. Cost, $80,000.

George F. Pelham, architect, has drawn plans for four five-story brick flats to be built on 103d Street, near St. Nicholas Avenue. Cost, $125,000.

Brazier & Simonson, architects, have drawn plans for a brick warehouse to be built on Center Street, near Elm Street. Cost, $80,000.

Lamb & Rich, architects, have planned a new brick edifice for the Washington Heights church at 145th Street, corner Convent Avenue. Cost, $80,000.

CHICAGO.—Building operations in Chicago are not large enough to attract much attention, unless we except the high board fence which the government has extended entirely around the block comprising the site of the new post-office. An advertising company will make beautiful this lofty screen. Think of 1,600 lineal feet of soap and breakfast food advertisements 12 ft. high shutting out the curious eyes of all the citizens who are patriotically anxious to see that all the pile foundations are properly driven!

While building statistics show an average of greater value as compared with the activity a year ago, yet business is slow. In the long list of Chicago building permits issued during a period of two weeks only three items were for buildings exceeding $14,000 in value, and only one was above $20,000. This latter was a street railway power house, by D. H. Burnham & Co., the cost being given at $65,000.

A new building project is a large factory for the New York Biscuit Company. The improvement, it is said, will amount to $250,000. Mr. S. A. Treat is the architect.

The school board, as usual, has some new school buildings under way; W. S. Patton, architect.

A fire-proof apartment building, to cost $125,000, has been reported. Mr. August Brosseau is named as the owner, who is having the plans made.

ST. LOUIS.—There is evidence of continued improvement in the building line in this city, and the outlook for the future is improving. The opinion seems to prevail, even among the most conservative, that the coming year will be the commencement of an unprecedented building era, and the number of investments being made by outside capitalists in the manufacturing and wholesale districts, and the large number of factories coming here from other cities, or being inaugurated among our own people, lends a color of truth to the prediction.

Only recently the Liggett-Myer Tobacco Company, finding it advisable to concentrate their business, erected in Dundee Place perhaps the largest tobacco manufactory in the world. The site is quite a

RESIDENCE FOR R. FULTON CUTTING, ESQ., 67TH STREET AND MADISON AVENUE, NEW YORK CITY.
Ernest Flagg, Architect.

distance from the business portion of the city, and at the time of its commencement was in a comparatively unsettled part of the city. The plant itself cost upwards of one and a half million dollars, and equally as much more has been expended in the immediate neighborhood in providing homes for the employees, etc.

In addition to this, the same architect, Mr. Isaac Taylor, has just awarded the contract for another tobacco factory in the same vicinity, being on Park Avenue and Lawrence Street. The building is for the Wellman-Dwire Tobacco Company, who intend moving here from Quincy, Ill., and is five stories high and 300 ft. long. The cost will be $100,000.

Eames & Young have let the contract for a five-story, slow-combustion building for the Cupples Real Estate Company. The building is one of the large number of buildings built by this company within the last few years at what is known as Cupples Station, the heaviest wholesale district in the city.

Another long-felt want is about to be provided in the erection of a passenger station at Vandeventer Avenue by the Wabash Railway. Architect A. M. Beinke's plans call for a building 100 by 350 ft., with Bedford stone for the basement, while granite brick and white terra-cotta will be used in the superstructure.

The same architect is also building a 60 by 130 ft. addition to the Christian Orphans' Home on Auburt Avenue.

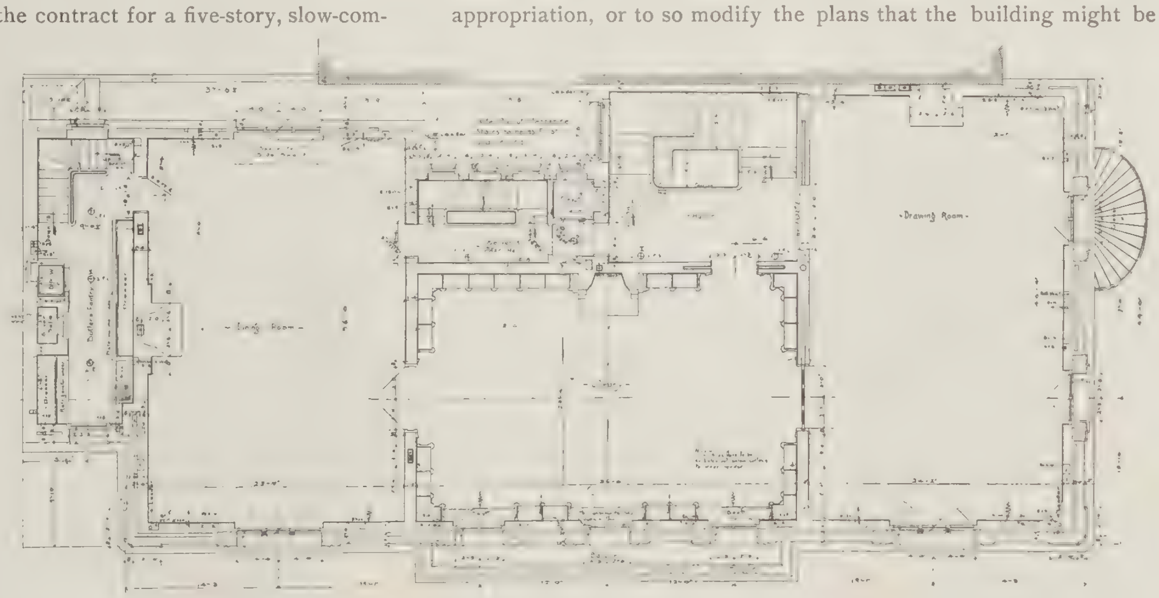
There has been another effort made to improve the northeast corner of Pine and 9th Streets, and it is to be hoped that better success may attend the effort than heretofore. This corner has had a peculiar history, two prominent citizens identified with schemes for its improvement having taken their own lives. After numerous failures by others, the owners undertook the erection of a ten-story building, but about the time the foundations were finished the stringency in financial circles caused a suspension of work, which has just been resumed again. The original idea of making the building ten stories will not be carried out at present, but seven are to be finished now, and later on it is expected that the other three stories will be added. Brick and terra-cotta will be used for the street fronts, while the construction will be of steel. About $150,000 will be expended.

The beautiful club house of the St. Louis Country Club, at Claton, which was destroyed by fire a few weeks ago, is to be rebuilt on a grander scale, and Shepley, Rutan & Coolidge have the plans about completed for same.

The same firm is also building a residence in Portland Place for Mr. J. H. Holmes, which will cost $65,000.

BUFFALO.— The better feeling amongst builders, which was noticed some two months ago, is pushing itself forward, and though, so far as large buildings are concerned, there is not a great deal of show, the building trade generally shows unmistakable signs of returning prosperity. There is already a slight rise in prices, which, it is to be hoped, will continue.

Last month the specifications for the new armory for the 74th Regiment, N. G. N. Y., were issued, and bids were asked for, with the result that the lowest bid was close on to $125,000 higher than the amount appropriated by the legislature. Naturally, there were only two courses before the commissioner, viz., either to take the lowest and finish the building as far as possible and trust to another appropriation, or to so modify the plans that the building might be



FIRST FLOOR PLAN.
RESIDENCE FOR R. FULTON CUTTING, ESQ., 67TH STREET AND MADISON AVENUE, NEW YORK CITY.
Ernest Flagg, Architect.
Elevations shown in plates 85, 86, and 87.

RESIDENCE, EDGEWATER, ILL.
George W. Maher, Architect.
Roofed with Spanish A tile. Manufactured by the Chicago Terra-Cotta Roofing and Siding Tile Company.

completed within the amount, $375,000. The latter course prevailed, and the State architect is now working hard on the plans, etc., in order to bring about the desired result. Captain Lansing, the resident architect, says that it is altogether likely that the building, instead of being built of stone, will be brick, though he thinks that the specifications could be cut down so as to leave the outer shell of stone, whilst altering the interior so as to bring the cost down to the required figure.

Phillips & Graves have prepared plans for a four-story brick and stone flat building on the corner of Main and Balcom Streets, to cost $50,000.

Architect Coxhead has made drawings for a new Roman Catholic school for the parish of St. Bridget's. It is to be built of brick with terra-cotta trimming, at a cost of $40,000.

Pentecost & Baggaley have filed plans for a five-story brick flat building, ten families, for Mr. W. Larkin, at 74 Day's Park. It will be practically fire-proof, and will have every convenience, including electric elevator.

Lansing & Beierl have deposited plans with the Bureau of Building for a Roman Catholic church on the corner of Alabama and Sandusky Streets. It will be built entirely of undressed stone, and will cost, exclusive of the interior fittings, about $40,000.

The new Federal building is beginning to look as though some thing were being done. The walls are now up to the second-story joists, and if the remainder of the work can be judged from present appearances, the building will be a credit to the contractor, and a decided acquisition to the architecture of Buffalo.

The competitive designs prepared by the eight selected local architects for the new banking premises for the Buffalo Savings Bank, to be erected on the corner of Main and Huron Streets, have been sent in, but it is not at all likely that any decision will be arrived at in the near future, as it has been decided not to start on the building until next spring.

BOSTON.— During the past thirty days there seems to have been a decided improvement in the condition of affairs as regards the building business in this city, and extending generally throughout New England. There are rumors of a number of large building operations that will in all probability come into the market before the first of the year. In the meantime contracts are being awarded, or at present being filled, on some fair-sized work, the plans of which have recently been completed. There is certainly considerable activity in the building of apartment houses in Boston and in the outlying sections. A larger number of these are being constructed of brick in preference to other materials than have been heretofore, which is encouraging evidence as to the increased popularity of well-constructed brick buildings, as compared with the flimsy wooden structures that in years past have been erected in sections where the law permitted.

Among the new buildings either now under process of construction or on which work will shortly be begun may be mentioned a large business block on India and Sears Streets, Hon. John D. Long, owner; Rand & Taylor, Kendall & Stevens, architects; to be constructed of brick. A $75,000 apartment house, corner of Brimmer and Pinckney Streets, John W. Bemis, architect, with Cabot, Everett & Mead, Boston; to be constructed of brick and limestone. The Boston Eye and Ear Infirmary's new hospital on Charles Street, Shaw & Hunnewell, architects. A $200,000 office building on India Street, Charles M. Dean, owner; Hartwell, Richardson & Driver, architects; George A. Fuller & Co., contractors; to be constructed of brick. New engine house for the Grove Hall district, Boston, Perkins & Betton, architects; L. K. Marston, contractor; to be constructed of brick and terra-cotta. The new building for the Massachusetts Institute of Technology (plans for which were prepared last year), to cost $150,000, Professors Chandler & Homer, architects; to be constructed of brick and terra-cotta. City Laundry Building, Wheelwright & Haven, architects; to be constructed of brick. New car house for the West End Street Railway, at Forest Hills, Boston; to be constructed of brick. Free Baptist Church, Warren Street, Roxbury, Mass., A. L. Darrow, architect; to be constructed of brick. New Catholic Church, to cost $100,000, at Whitinsville, Mass., for the St. Patrick's Catholic Parish, Charles D. Maginnis, architect, Boston; to be constructed of brick and stone. $200,000 building for the Hartford Brewing Company, Hartford, Conn. Adam C. Wagner, architect, Hartford; to be constructed of brick. $50,000 business block, Malden, Mass., Tristram Griffin, architect, Boston; to be constructed of brick. $150,000 hotel at Pittsfield, Mass., Samuel W. Bowerman, owner, Pittsfield, H. Neil Wilson, architect, Pittsfield; to be constructed of brick and stone. Society hall and dormitory at New Haven, Conn., Brite & Bacon,

RESIDENCE, COMMONWEALTH AVENUE, BOSTON.
McKim, Mead & White, Architects.

EXECUTED IN TERRA-COTTA FOR THE ERIE LIBRARY, ERIE, PA.
Alden & Harlow, Architects.
By the Northwestern Terra-Cotta Company.

architects, New York City; to be constructed of brick. New high school at Brockton, Mass., C. L. Mitchell, architect, Brockton. New school, Fall River, Mass., L. G. Destremps, architect, Fall River; to be constructed of brick.

NEW TRADE LITERATURE.

THE disposition to freely introduce the open hearth as an essential and important feature in the construction of the modern dwelling is certainly a tendency in the right direction, and one that deserves every encouragement.

Viewed both from an artistic and sanitary standpoint, the general adoption of the open fireplace in the living and sleeping rooms of our habitations is most desirable and should be strongly urged. No part of our home contributes more to the comfort and health of the inmates than the chimney corner. Its quiet influence of good cheer is impressive and restfully effective, while the peaceful charm of its bright circle lends contentment to the mind. Taken from a sanitary standpoint, the open hearth has much to recommend it. Perfect ventilation is a necessity for any healthy habitation, and the best possible ventilator is an open fireplace. With the coming of the hot-air furnace the fireplace passed into disregard. For many years its virtues were ignored and its artistic possibilities lost sight of. Comparatively very few of the new houses then erected embodied the fireplace in their construction, while most of those that existed in the old habitations were sealed from use. Within the past few years all this has changed; the claims of the open hearth to popular favor are once more recognized and far better understood. At present there is hardly a structure built for residential purposes but that contains its open fireplace, no matter how inexpensive is the dwelling.

In connection with this subject an interesting and instructive volume has reached our table, which we earnestly recommend to the attention of our readers. This work is entitled "The Open Hearth," and is issued by Fiske, Homes & Co., 166 Devonshire Street, Boston, for distribution among the architects and builders. While this work is published with the objective view of bringing to the attention of the architectural profession the large assortment and artistic beauty of the line of fireplaces which the firm manufactures, yet in its compilation they have gone far beyond the standard of a mere catalogue, and have amassed together such material as make it of real interest to the architect, by virtue of the many valuable suggestions therein contained.

There are some thirty full-page illustrations of the different styles of fireplaces that the firm carry in stock, facing which, on the opposite page, is a full description of the fireplace illustrated. These designs embrace a wide range of patterns, each being especially adapted to harmonize with the particular requirements of various

BRICK AND TERRA-COTTA FIREPLACE MANTEL, DESIGNED FOR FISKE, HOMES & CO., BOSTON.
Built of 8½ by 2½ in. bricks, with a border and shelf course enriched by leaf and bead and reel moldings. Height, 57 ins.; height of shelf, 50 ins.; projection of shelf, 7½ ins.; width, 64 ins.

rooms, from banquet hall to bath room, and range in price from the most expensive of patterns to those of a surprisingly low cost.

We certainly recommend to our readers a careful perusal of "The Open Hearth," a complimentary copy of which may be had by addressing Fiske, Homes & Co., 166 Devonshire Street, Boston, Mass.

WE are in receipt of a very interesting catalogue from the Lehmann-Kohlsaat Clay Works, Chicago, that explains in a most comprehensive way a number of new and special features which the firm are introducing in a line of clay products now being placed by them upon the market. A very complete set of over seventy illustrations serve to make the purpose of these features easy to comprehend.

Special attention is called to what they term their "Angle Iron Fire-proofing Construction, Wall, Floor, Ceiling, and Roof, all made of the same tile in connection with angle iron, which offers a perfect protection of the iron and wood construction, combines lightness with strength, and can be constructed with ease and economy."

The particular feature of this invention is the embedding entirely of the angle iron between the tiles.

Now that the subject of the best and most approved methods of fire-proofing is justly receiving so much attention, it would not be amiss for such of our readers as are interested in the question to obtain a copy of this catalogue. Address Lehmann-Kohlsaat Clay Works, Chicago, Ill.

ITEMS OF INTEREST AND VALUE.

THE contract for the buff terra-cotta for Everett, Mass., grammar school has been awarded to Waldo Brothers.

T. W. CARMICHAEL, manufacturer of clay steamers, has removed from Wellsburg, W. Va., to Clarksburg, W. Va.

THE white terra-cotta to be used in the new Casino and Pergola for Hon. Charles F. Sprague, Brookline, Mass., will be furnished by Waldo Brothers.

T. W. CARMICHAEL reports the sale of his fifteenth clay steamer for the season, the purchaser being the Clarksburg High-Grade Shale Brick Company, Clarksburg, W. Va.

TERRA-COTTA MULLIONS, SHOWING FACE AND REVEAL, STORE FRONT, CHESTNUT STREET, PHILADELPHIA, PA.
F. R. Watson, Architect.
Made by the Conkling, Armstrong Terra-Cotta Company.

THE Gale Automatic Safety Sash Lock will be used in the Dun Building, at the corner of Broadway and Reade Street, New York City; Harding & Gooch, architects.

WALDO BROTHERS are furnishing Alsen Portland and Hoffman Rosendale cement to Norcross Brothers for Congregational Building, Beacon Street, Boston.

G. R. TWICHELL & Co., Boston, have secured the contract to supply the buff brick to be used in eight apartment houses on Washington Street, Brookline, Mass.; also four apartment houses at Allston, Mass.

WALDO BROTHERS have secured the cement contract for Longwood Avenue Bridge, Boston, furnishing Atlas Portland and Hoffman Rosendale; Woodbury & Leighton, contractors.

THE CONKLING, ARMSTRONG TERRA-COTTA COMPANY have secured through their New England agent, Charles E. Willard, Boston, the terra-cotta on the St. John's Parish Church, East Boston, Mass.

WALDO BROTHERS have the contract for furnishing the white terra-cotta for new Telephone Building, Newport, R. I.; Perkins & Betton, architects, Boston. Elaborate modeling will be used.

THE MOUNT SAVAGE ENAMELED BRICK COMPANY, Mount Savage, Md., have secured through their New England agents, G. R. Twichell & Co., Boston, the contract to supply the enameled brick to be used in a residence at Somerville, Mass.; Samuel D. Kelley, architect; D. W. Welch, builder; also a residence in Readville, Mass.; Karl Zerrahn, architect; Mitchell & Sullivan, builders.

CHARLES E. WILLARD, Boston, has secured the contract to furnish the white brick to be used in a large business block in Worcester, Mass., also the fire-proofing to be used in the L. W. Bessee Block, Springfield, Mass.

THE RIDGWAY PRESSED BRICK COMPANY, Ridgway, Penn., have secured through their New England agents, G. R. Twichell & Co., the contract to supply the gray brick to be used in the new Catholic Church, at Jamaica Plain, Mass.; P. W. Ford, Boston, architect.

THE SHAWMUT BRICK COMPANY have secured through their Boston agent, Charles E. Willard, the contract to furnish the buff brick on the Moriarty Block, Waterbury, Conn., and in the residence for the Sisters of the Sacred Heart, Jamaica Plain, Mass.

G. R. TWICHELL & Co., Boston, have secured the contract to supply the brick to be used in the new car house for the West End Street Railway, at Forest Hills, Mass.; also for a new schoolhouse, at Dedham, Mass.

THE WEBSTER BRICK COMPANY, South Webster, Ohio, have secured through their New England agent, Charles E. Willard, Boston, the contract to furnish the mottled brick in the Standhope Building, Providence, R. I.

IT will interest those using Portland cement to learn that the N. Y. C. & H. R. R. R. Company has just executed a contract to use Alpha Portland cement stone entirely in the erection of the new Grand Central Station, 42d Street and Vanderbilt Avenue, New York City.

A CONTRACT has just been closed by Edward R. Diggs & Co., for placing nearly five hundred of the Bolles' Sliding and Revolving Windows in the new office building of the English-American Loan and Trust Company, of Atlanta, Ga.; Bradford L. Gilbert, architect, of New York.

THE SAYRE & FISHER COMPANY have secured through their

Boston agent, Mr. Charles Bacon, the contract to supply the gray-mottled brick to be used in the new Terminal Station, at Boston; Shepley, Rutan & Coolidge, architects; Norcross Brothers, contractors. These bricks are of a special color, and of Norman shape (dimensions, 12 by 4 by 2¼ ins.).

MEEKER, CARTER, BOORAEM & CO., New York City, have, since May 1, 1897, sold over eight million paving brick for the Eastern Paving Brick Company, for whom they are Eastern selling agents. Their last contract, recently closed, calls for six million bricks to be supplied the town of Jamaica, N. Y., which will be used in gutters on forty miles of street improvement, the roadways being macadamized. This is one of the very largest, if not the largest contract for paving brick ever closed in this country.

THE RIDGWAY PRESSED BRICK COMPANY, Ridgway, Penn., have secured through their Boston agents, G. R. Twichell & Co., the contract to supply the gray brick in the Free Baptist Church, Roxbury, Mass.; A. L. Darrow, architect, Boston; also the gray brick to be used in eight apartment houses, corner of Columbus Avenue and Northampton Streets, Boston; D. D. Kerns, architect; also the gray brick to be used in the apartment houses on Northampton Street; T. A. Tracey, architect.

THE AMERICAN ENAMELED BRICK AND TILE COMPANY are supplying their patent interlocking tile for the halls of the College of History, American University, Washington, D. C.; James L. Parsons, builder; also the elevator shafts in the Gatlin Building, Hartford, Conn.; Hopkins & Roberts, builders. They are also making a large delivery on contract closed three months ago, to supply semi-glazed front brick for the new Dun Building, Broadway and Reade Streets, New York City; W. A. & F. I. Conover, builders.

TERRA-COTTA CAP TO COLUMN, INTERIOR OF ENTRANCE, SYRACUSE UNIVERSITY, SYRACUSE, N. Y.
Green & Wicks, Architects.
Made by the Perth Amboy Terra-Cotta Company.

THE CELADON TERRA-COTTA COMPANY have recently supplied their roofing tiles on the following work: Residence, W. B. Snyder, Newark, N. J., buff Conosera; Thomas Cressey, architect. Residence, W. H. Lawrence, Cleveland, Ohio, red Conosera; Coburn & Barnum, architects. Passenger station, Illinois Central Railroad, Springfield, Ill., red closed shingle; F. T. Bacon, architect. Gate lodge, National Soldiers' Home, Dayton, Ohio, brown Conosera; Peters, Burns & Pretzinger, architects. Gate lodge, Woodlawn Cemetery, Everett, Mass., red open shingle; Wm. Hart Taylor, Boston, architect.

THE OHIO MINING AND MANUFACTURING COMPANY, makers of the "Shawnee" front brick (works at Shawnee, Ohio), have sent us four samples of their product, which we are glad to recommend as being a splendid brick in every particular.

The colors are a light mottled buff, a dark mottled buff, a cream white, and a chocolate brown. The surface texture of the bricks is fine, and the sharp metallic ring which they give when struck with a hammer shows that the clay has been well burned, which is one of the principal requisites of first-class brick.

"PEOPLE have gone wild on the reports of rich gold finds in Alaska, and are willing to undergo the perils and discomforts of the frigid North to extract from its frozen soil the nuggets which will bring them wealth. You don't need to go to Alaska! There is a 'golden opportunity' right here at home. It lies within your power to extract from the earth around you 'golden bricks,'" says the American Clay-Working Machinery Company, on an attractive novelty advertising card which they have recently sent out. "Your clay with our machinery will bring you gold without the privations of Alaska. The demand for good brick and other clay products is going to be heavy; get ready to meet it."

A NOVEL application of the Mason Safety Tread has recently been completed in New York, which attracts the notice and elicits the commendation of pedestrians. Set in the sidewalk in front of the office of the New York *World* is an immense iron circle representing the globe. As the sidewalk toward Frankfort Street has a decided pitch, this circle, worn to a polish by the great amount of traffic, became a source of constant danger, especially in wet weather. With its smooth outlines and zones covered with stripes of the Mason Safety Tread, the danger of slipping is removed, and the illustrative effect of the great globe is intensified.

WE would call the attention of those of our readers who are interested in the manufacture or sale of clay products, to the particularly desirable property which is offered for sale on page xxxvii of this issue. This property is located in the northwestern portion of Pennsylvania, and is so situated as regards shipping facilities as to have cheap and easy access to the markets of the Middle and New England States. The property is said to contain twelve different kinds of fire-clay and shale in inexhaustible quantities, which burn white, buff, pink, salmon, and red in color. These clays are of such a quality as to be particularly suitable for the manufacture of all kinds of brick and terra-cotta products. The fact of the extreme cheapness of fuel in this section is an item of considerable importance in the cost of manufacturing.

THE CHICAGO TERRA-COTTA ROOFING AND SIDING TILE COMPANY report the following buildings completed last month on which their goods were used for roofing:—

Woodmere Cemetery Gate, Detroit; Donaldson & Meier, architects; house and barn, F. B. Stevens, Detroit; Donaldson & Meier, architects; depot, Kansas City, Pittsburg & Gulf Railroad, Point Arthur, Texas; George Matthews, Architects; residence for P. Wheeler, Mr. Pruyn, architect; office East End Avenue, Chicago, building, Battle Creek Steam Pump Company, Battle Creek, Mich.; R. T. Newberry, architect; residence, Michigan Avenue, Chicago; Charles S. Frost, architects; two houses for Mrs. Fellows, Chicago;

RESIDENCE AT PORTSMOUTH, N. H.
Ball & Dabney, Architects.

Cowles & Ohrenstein, architects; residence, Grand Boulevard, Chicago; J. F. & F. P. Doerr, architects; residence, Sullivan, Ind.; Wing & Mahurin, architects; carriage house for E. S. Pike, Beverly Hills, Ill.; H. H. Waterman, architect; apartment building, Chicago; J. F. & F. P. Doerr, architects; three-apartment building, Chicago; Burtar & Gassman, architects.

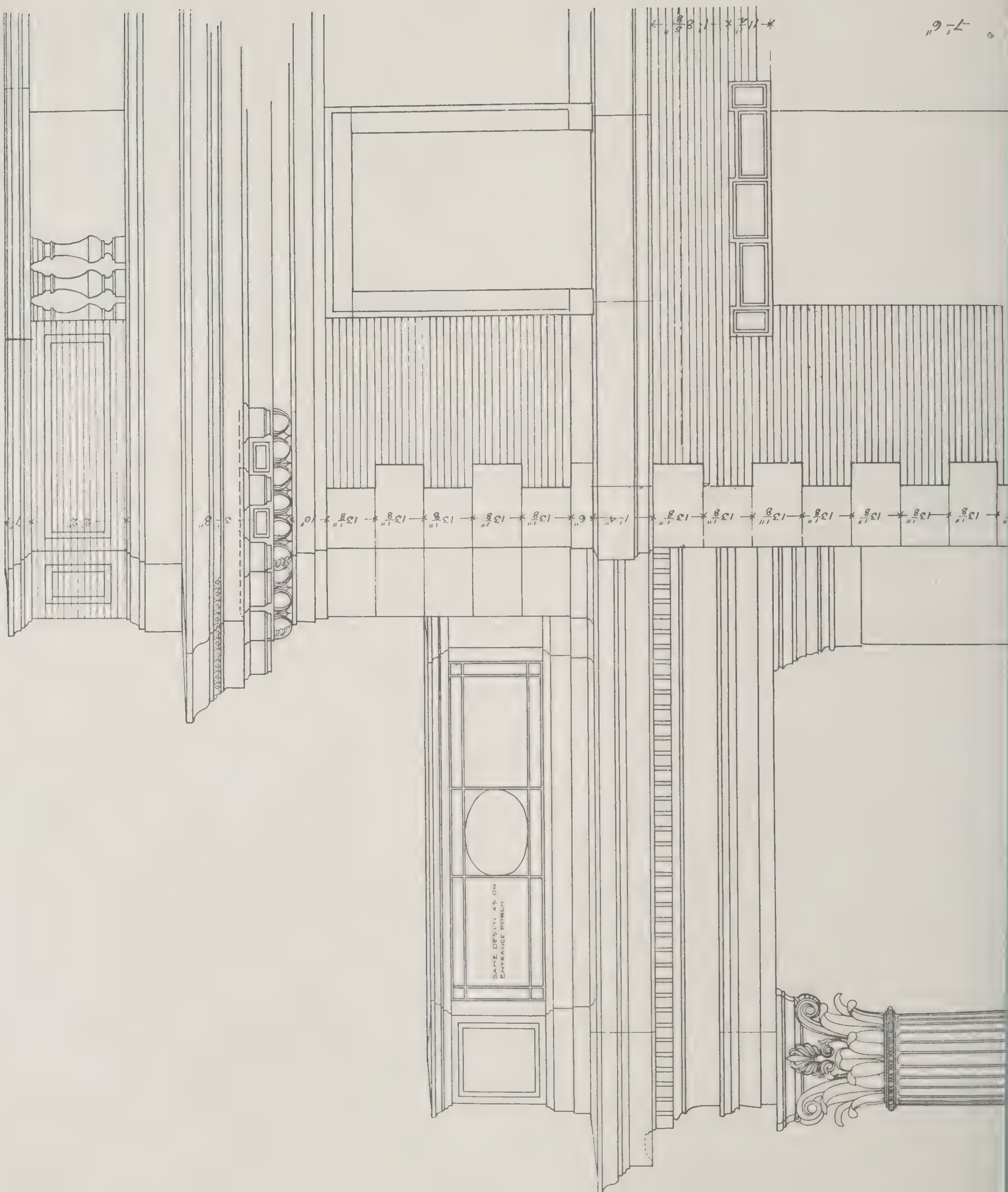
THE BOSTON FIRE-PROOFING COMPANY are furnishing the terra-cotta fire-proofing on the following large buildings: The new Converse Building, corner Milk and Pearl Streets, Boston; Winslow & Wetherell, architects, L. P. Soule & Son, contractors. Puritan Brewery, Charlestown, Mass.; Hettinger & Hartman, architects, Mack Brothers, contractors, Salem. Jewelers' Exchange, Bromfield and Washington Streets; Winslow & Wetherell, architects, Geo. A. Fuller & Co., general contractors.

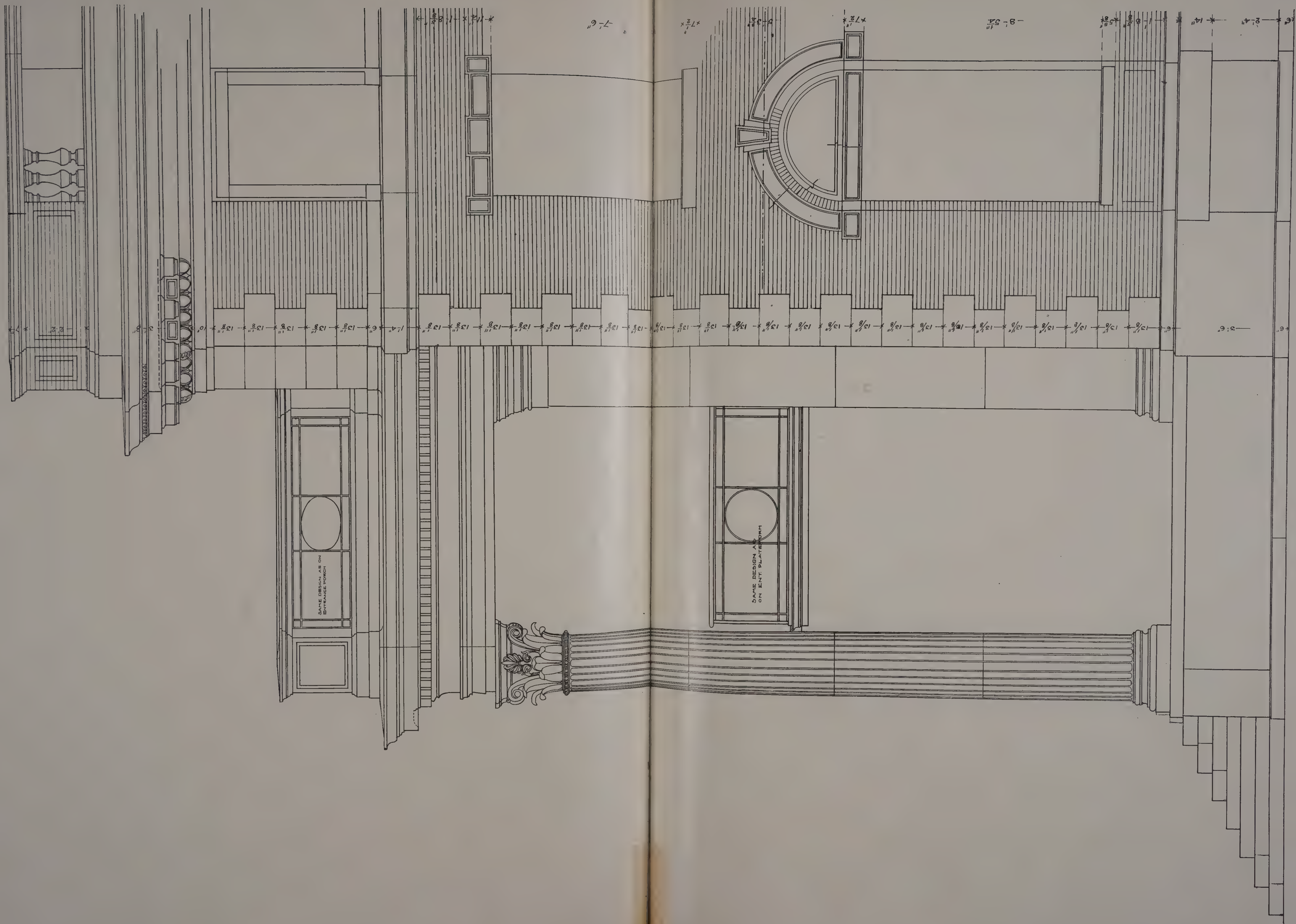
SAYRE & FISHER COMPANY have secured the contract through their Boston agent, Mr. Charles Bacon, to supply the enameled brick to be used in the interior of the new engine house now being built at Grove Hall, Boston; Perkins & Betton, architects, L. R. Marston, contractor.

O. W. PETERSON & Co. are supplying the dark speckled buff brick for the St. Alphonso Hall, Roxbury; F. Joseph Untersee, architect.

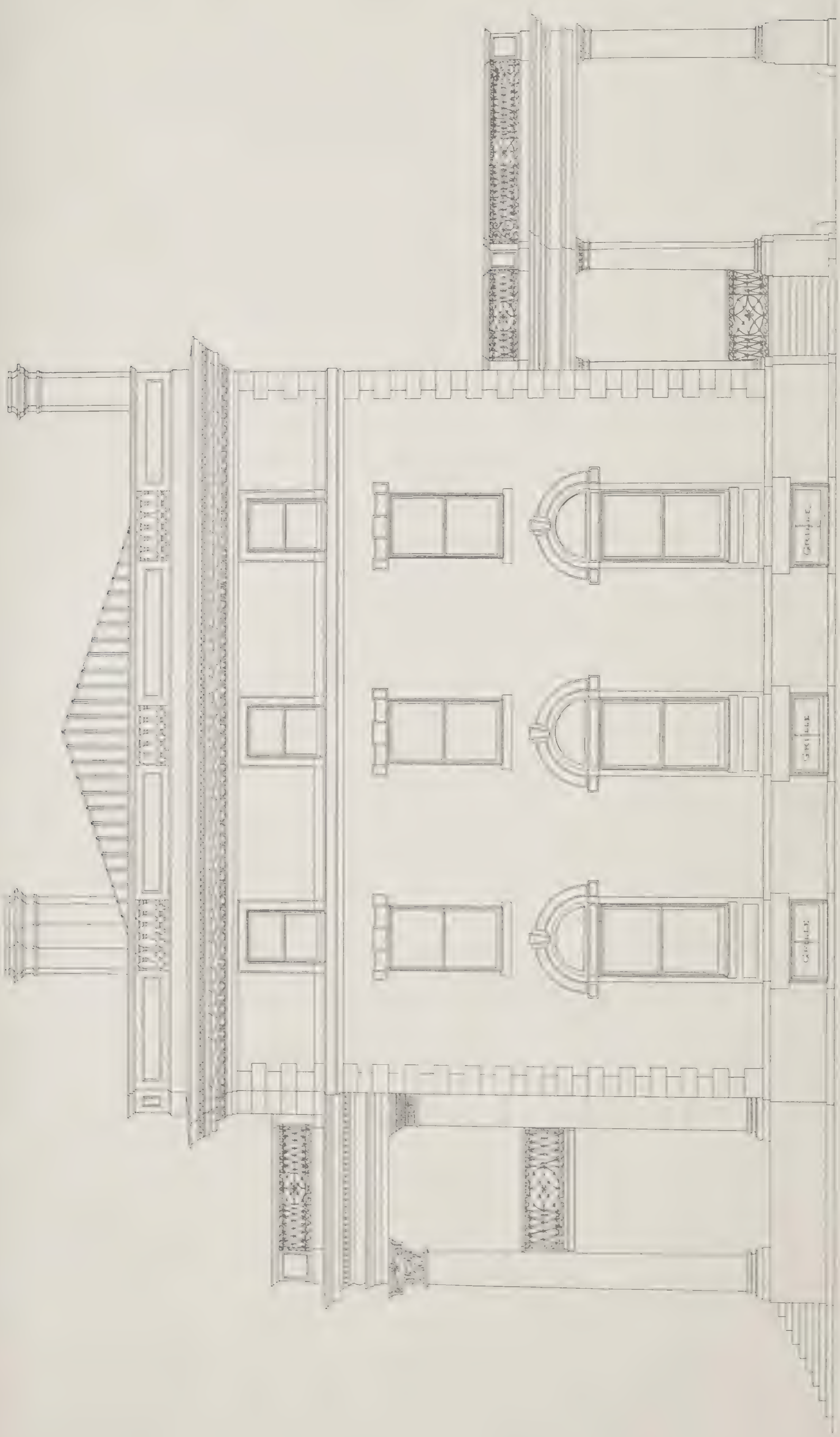
CHARLES E. WILLARD is supplying the old-gold mottled brick that is being used in the Macabe Building, New Britain, Conn.; W. H. Cadwell, architect, New Britain, O. W. Curtis, contractor.

THE STANDARD TERRA-COTTA COMPANY are supplying, through their New England agents, O. W. Peterson & Co., the terra-cotta for a new hotel at the corner of Snow and Weybosset Streets, Providence, R. I.; W. R. Walker & Sons, architects, Providence, M. J. Houlihan, contractor.


SAME DESIGN AS ON ENTRANCE PORCH



DETAILS, HOUSE FOR GEORGE L. WILLIAMS, Esq., BUFFALO, N. Y.
McKIM, MEAD & WHITE, Architects.

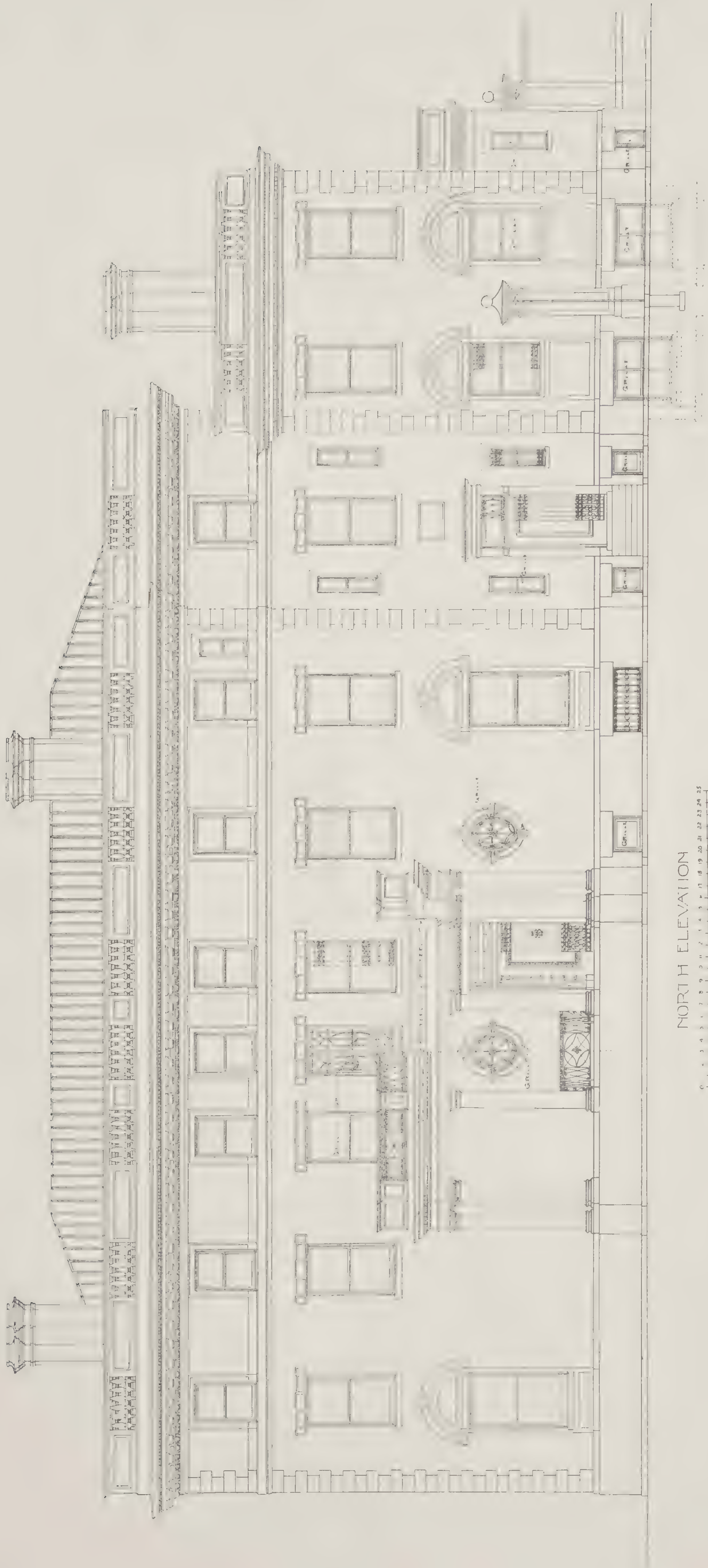


EAST ELEVATION

SCALE

HOUSE FOR GEORGE L. WILLIAMS, Esq., BUFFALO, N. Y.

McKIM, MEAD & WHITE, ARCHITECTS.

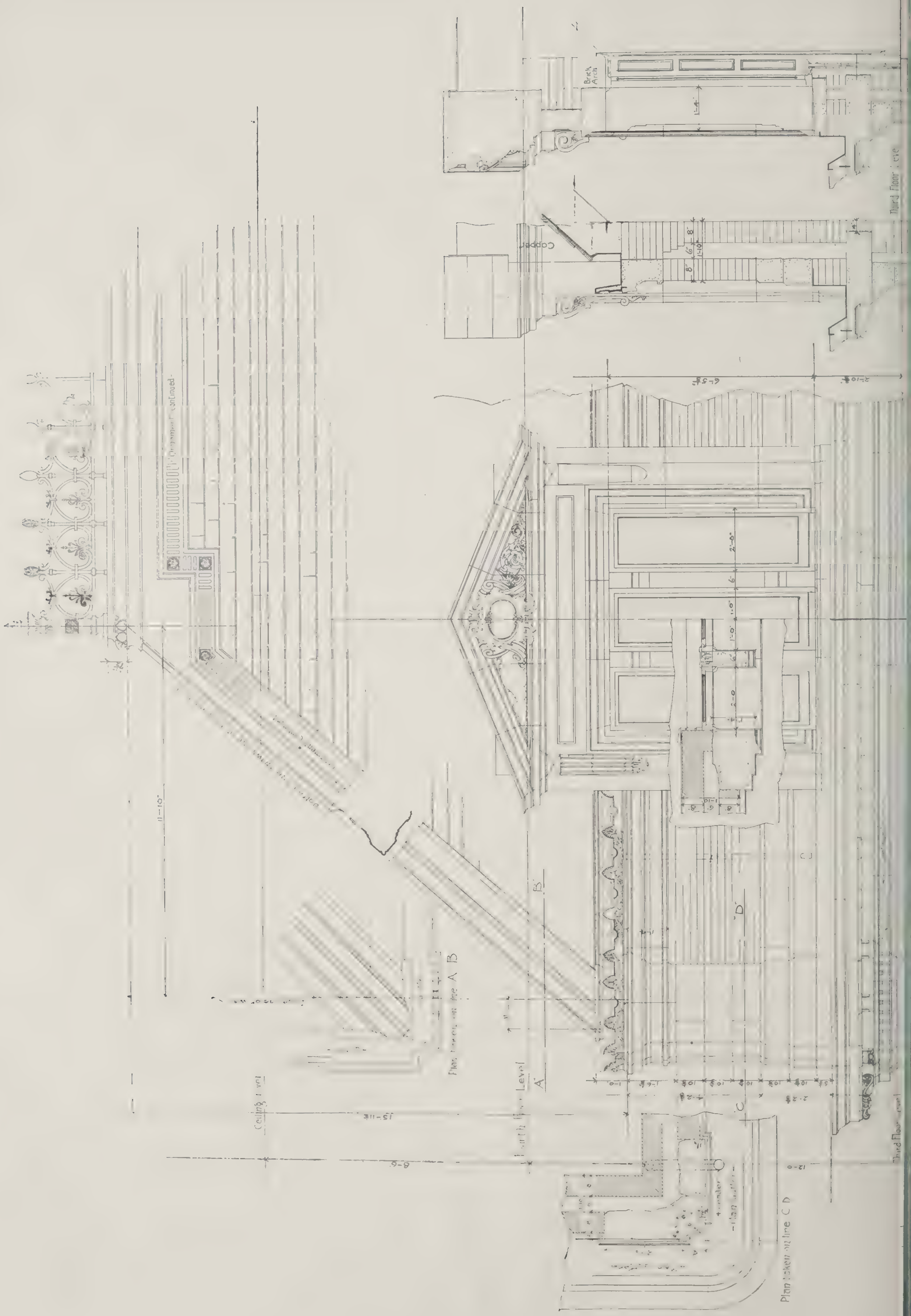


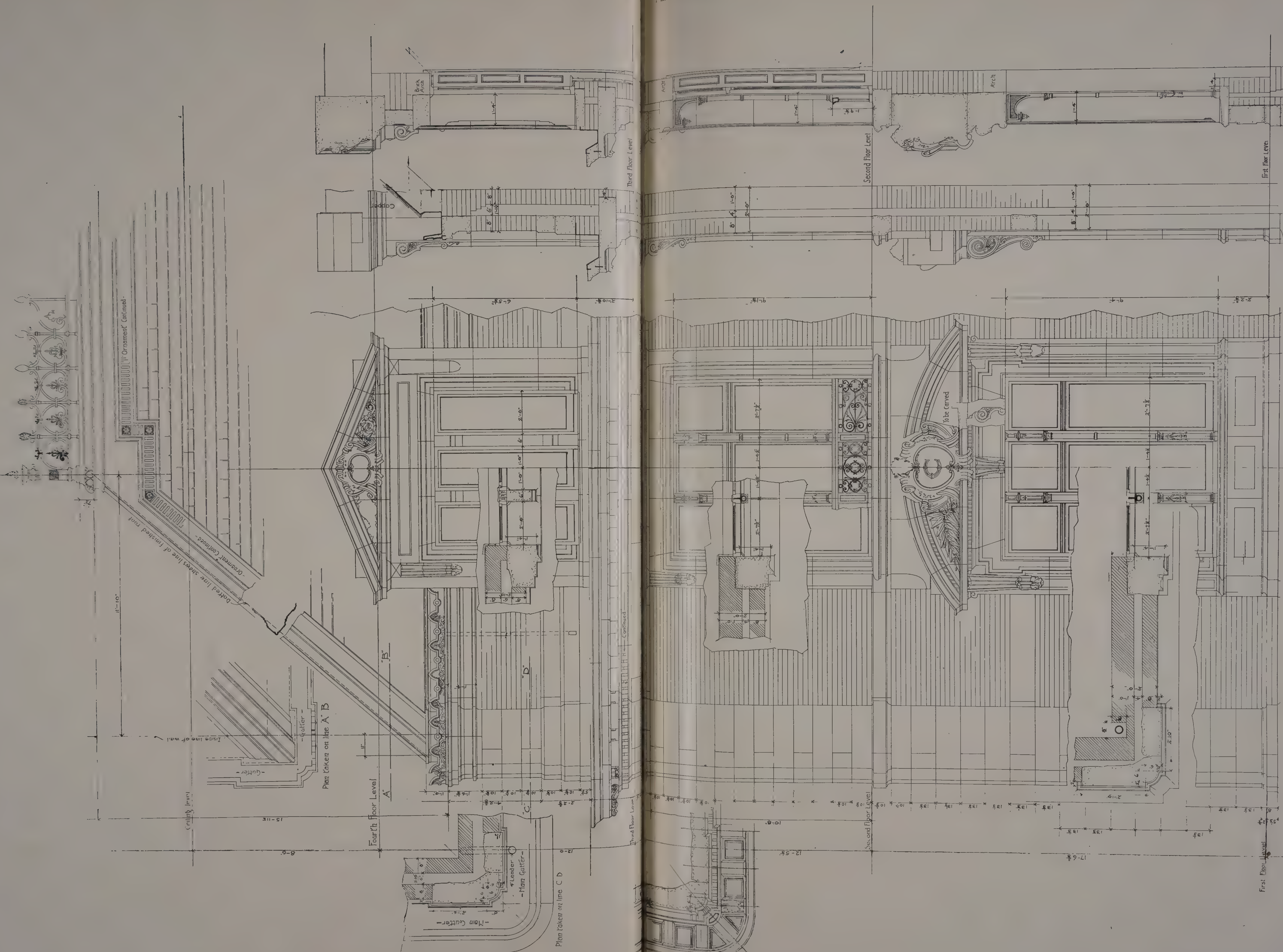
NORTH ELEVATION

SCALE OF FEET

HOUSE FOR GEORGE L. WILLIAMS, Esq., BUFFALO, N. Y.

McKIM, MEAD & WHITE, ARCHITECTS.

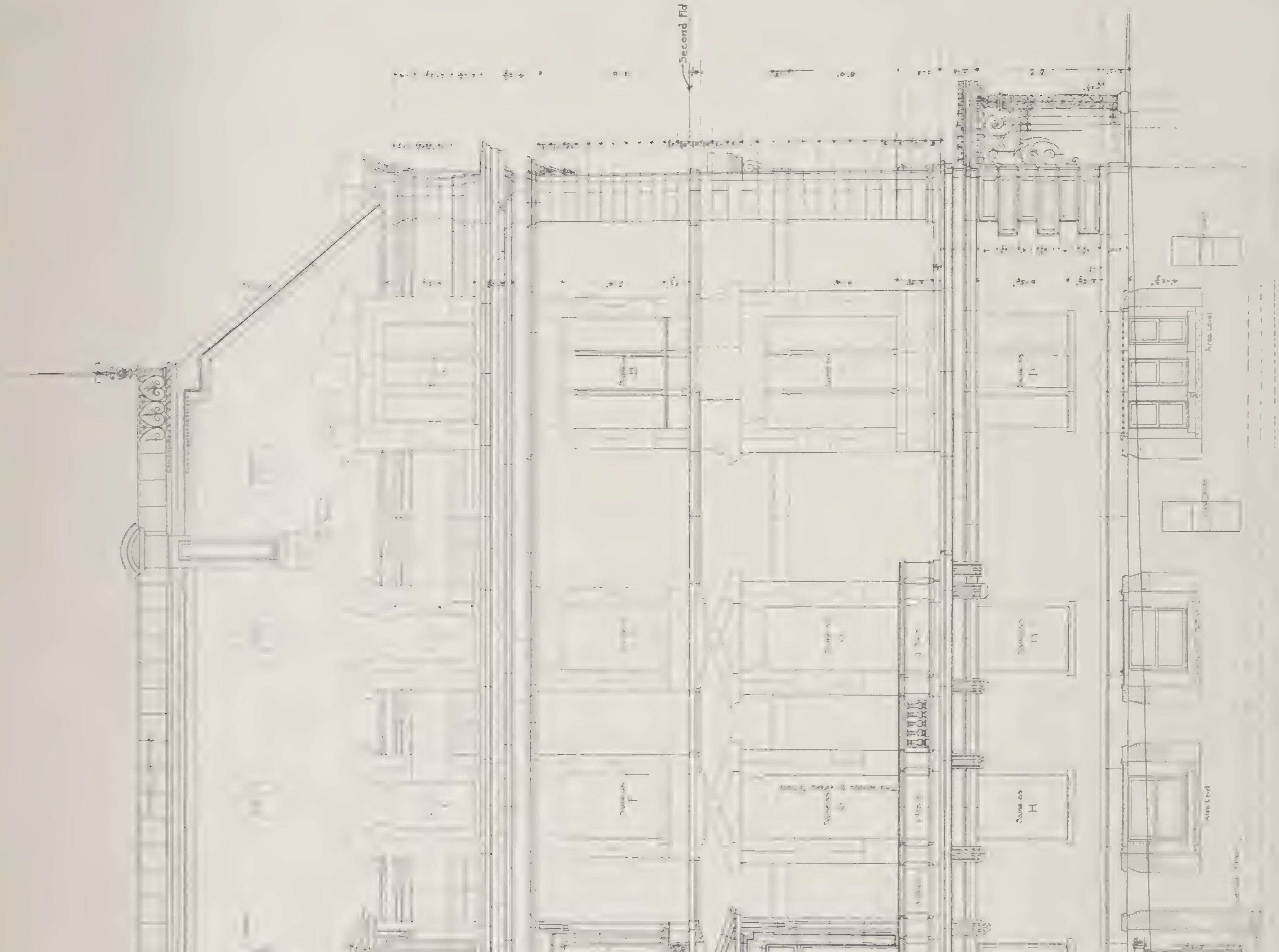

Brick Arch
Copper
Ornament continued
Plan taken on line A B
Plan taken on line C D
Ceiling Level
Third Floor Level
A
B
C
D



RESIDENCE FOR R. FULTON CUTTING, Esq., MADISON AVENUE, NEW YORK CITY.

Details of Bay Showing Triple Windows.

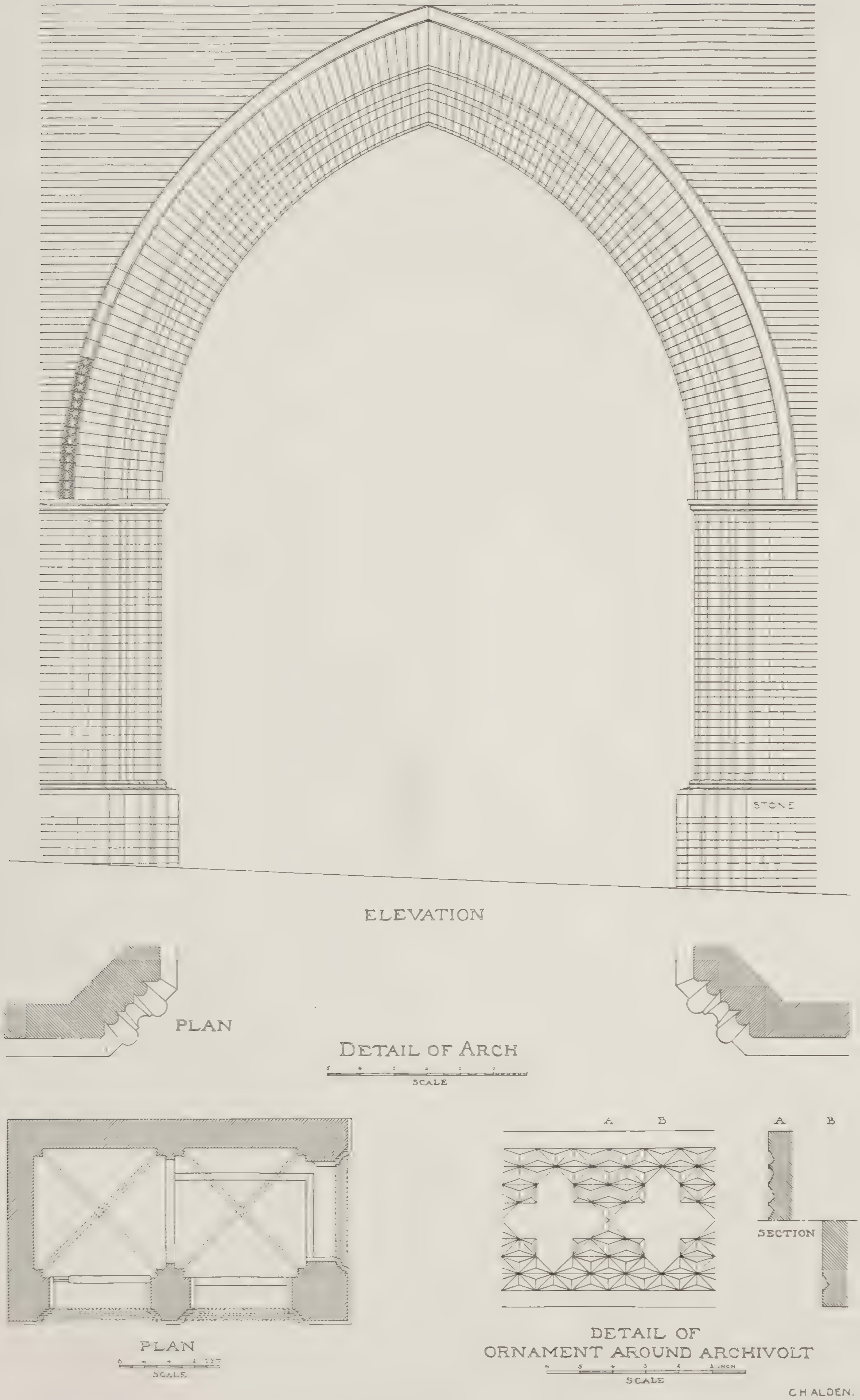
ERNEST FLAGG, Architect.



MADISON AVENUE ELEVATION.

RESIDENCE FOR ... STREET AND MADISON AVENUE NEW YORK CITY.

ERNEST FLAGG, ARCHITECT.



MEASURED DRAWING OF FONTE NUOVA, SIENA.

(This is one of the old fountains owned by the municipality and leased to washerwomen. It was built at the close of the thirteenth century. It is of dark-red brick, 11 ins. x 5¼ ins. x 2¼ ins., bonded irregularly.)

VOLVME VI NOV. 1897 No. 11

THE BRICKBVILDER

OFFICE 85 WATER STREET BOSTON

THE BRICKBUILDER.

AN ILLUSTRATED MONTHLY DEVOTED TO THE ADVANCEMENT OF ARCHITECTURE IN MATERIALS OF CLAY.

PUBLISHED BY

ROGERS & MANSON,

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IT is so much easier to see the outs than it is to appreciate the ins, that we often hear a great deal more of the objections to brick and terra-cotta as building materials than we do of their excellent qualities. The criticism, so called, which is leveled against products of this description is very apt to be limited to fault finding and invidious comparisons without any attempt to show how the best results can be obtained with this vehicle. No material which is used for building construction is perfect, and so long as human agencies are the medium through which a structure is evolved, so long will mistakes and errors of judgment occur. There are naturally, therefore, directions in which the value of brick as a material can be greatly increased and the desired results more readily accomplished. The architectural profession is an extremely critical one. By training, by association, and as a matter of self-protection, architects are forced to be conservative in their views, to take slowly to new inventions or methods, to hold fast to established ways, and to let experiments be tried by the unwary and unprofessional; while because of the retrospective character of the architecture of the present day the new forms of brick and terra-cotta sometimes receive scant favor when first put on the market, and a color or texture which does not find a precedent in the work of the past obtains slow recognition. This is in a way as it should be, and yet the spirit of conservatism which would exclude doubtful products or reject untried methods must not be carried to the extent of ignoring possibilities or of exacting more than can fairly be required of the burnt clay products. We have very nearly outgrown the spirit which would prompt an architect to discard the more finished, workmanlike products of our kilns in favor of the crude, misshapen, but finely textured brick which was so much in favor a few years ago We occasionally find instances where the rough, unfinished look is sought for and where an appearance of studied carelessness is considered to be equivalent to an artistic effect. Without undertaking to question the picturesque possibilities of an imperfect brick or a poorly burned piece of terra-cotta, we do feel, and we find this belief is quite generally accepted, that better results will be obtained in every case by the use of the best product that our manufacturers can turn out; and if it is desirable to procure such excellence of product, our architects can lend great aid by their personal encouragement of the efforts which are every year put out by our manufacturers to more fully and completely meet the artistic growth of the country. It is very easy to find fault with the size of the brick, the sharpness of the edges, or the variations in tone, but if instead of indulging such a captious spirit we would be prompt to recognize a good brick when we see it, and not only recognize it by a pleasant word spoken to the manufacturer or salesman, but to acknowledge it in the more practical method of using it in our buildings, it would be much easier in a few years to secure the uniformity of product which is so generally desired. And with this uniformity it is our belief that the artist's desire to employ the rough or crudely burned product would be very much lessened, the element of uncertainty could be handled with more precise results, and our architectural designs would be clearly expressed in a medium that we could depend upon. Good brick always costs money. Terra-cotta which is irregular in shape, imperfect in burning, and out in color is of course a great deal cheaper than the product which is firm, even, and true. We all want the latter. If the architects would insist upon having nothing but that and should not give their clients even the opportunity of electing to take the cheaper material, but consider that terra-cotta and brick always means good terra-cotta and brick, and if not always the very best the market affords, at least a fairly reliable first-class product, there would be less cause for complaint on the score of poor material, and the manufacture would be raised more nearly to the ideal of which we believe it is capable.

IN the fire-proofing department of our last issue we called attention to some conditions which exist under the so-called fire-proofing laws. Since then an illustration in point has been brought prominently into notice. A building has recently collapsed in Boston under conditions which were so exasperating that it is hard to have patience with either the authorities which will allow or the statutes which will tolerate such occurrences. The building law of Boston, very wisely, we believe, provides that every building to be used as a tenement or lodging house shall be fire-proof in the first story, and that every building used under certain conditions so as to be practically a hotel shall be entirely fire-proof; but, unfortunately, the law does not apply to alterations, or, perhaps, to be more exact, the ordinance is not clear in defining the limits of what can be passed as an alteration. Boston is full of old tumble-down structures which have been used for tenement houses for years. These have been acquired quite extensively during the past decade by a class of property owners who care so much more for revenue than for a decent building that their continual increase in the acquisition of such property constitutes a serious menace to good construction, to say nothing of danger to life and limb, for the reason that these old structures when acquired, invariably undergo a species of rebuilding and repairs, and

as in nine cases out of ten the structures were orginally but imperfectly built, they are seldom improved by the alterations. In this particular instance, in order to enlarge the building and at the same time avoid the requirements of fire-proof reconstruction, the building underwent what was claimed to be a process of alteration; but as only the wall on the party line and the floor beams themselves were left intact, the elastic limit of the statute was very closely touched. Some of the walls were only 4 ins. thick, none of them were well built, and the work of alteration was confided apparently to a set of mechanics who know almost nothing about proper building, with the natural result that before the work was half completed it all tumbled into the cellar. Boston's building law is in theory a very fair one, but in practise it allows loopholes of sufficient size to permit of outrageous violations of what ought to be considered fairly good practise. There is no possible excuse for the collapse of any building. With ordinary care and a slight mixture of intelligence the most extensive alterations can be carried through without the slightest danger or risk, but with poor masonry, mortar which is nearer mud than anything else, and mechanics who are ignorant of the ordinary principles of building, coupled with an elastic interpretation of a law which at the best can only be vague in its limitations, the wonder is we do not have more accidents than really occur.

BONDING OF BRICKWORK — CORRESPONDENCE.

EDITOR THE BRICKBUILDER.

Dear Sir: — Your editorial on the bonding of brickwork, in the October issue of THE BRICKBUILDER, touches upon one of the most serious evils in American building. It is not unusual to find bad methods tolerated because they are less expensive, but it is rare indeed to find a distinctly wrong practise that is also more costly from the start. This is most emphatically true of the practise of veneering walls of common brick with "face" or pressed brick. We must now make the real burden-bearing wall of the full thickness necessary to carry the load of roof and floors and then add the 4 in. skin of face brick, bonding this to the real wall in various questionable ways that impair the strength of the backing. All of this iniquity of weak construction and unnecessary expense is due to difference in coursing of front and common brick.

I am unable to explain the origin of the numerous brick sizes, but it is fair to presume that many of the existing dimensions are arbitrary, and can, therefore, be changed without shaking the foundations of society. If the common brick would course with the face brick used in the body of the wall and were accordingly laid with bonding of header bricks, we should at once do away with the extra 4 ins. of thickness, and could consider the face as an integral part of the wall, capable of bearing its share of the imposed load. These advantages are entirely economical and constructional and sufficient to justify the changes suggested. The esthetic gain would be most desirable; we should have in the place of the characterless wall face composed entirely of stretchers, a wall diversified by the exhibition of ends of the headers, and suggesting, even to the layman, thickness and strength.

The charm of the colonial brickwork is due more to the evident bonding than to picturesque combination of the dull red brick and thick joints of white mortar. Many architects are now insisting upon the so-called Flemish bond on the face of exposed brickwork, but they are satisfied to have the appearance without the strength, as they are content to have show headers. In some of the recent work selected common brick have been used on the face of the wall, and the bonding has therefore been honest. To have real bonding between face brick and common is at present almost impossible. I know of but one satisfactory example, and this was only possible by having the face brick made of special dimensions to course with the common brick. The building referred to is the recently constructed Jefferson Hotel in Richmond, Va. As every inch of the walls could be counted upon to carry its share of load, the saving in space and in expense by avoiding the extra thickness became in this extensive building a very large item.

The consideration of this question brings us at once to another and important one, which is, the existing variation in dimensions of common brick from different districts. We should have throughout this country a uniform standard of size for common brick, and then we can logically proceed to fix upon a size of face brick which will course with it.

I hope that THE BRICKBUILDER will continue to direct the attention of architects, masons, and brickmakers to this matter.

OWEN BRAINARD.

NEW YORK CITY, Nov. 15, 1897.

EDITOR THE BRICKBUILDER.

Dear Sir: — According to your invitation in the October number of your highly esteemed paper, regarding improvement on American bond, I will submit to your readers the practise I have followed for some time; a simple method which not only gives no additional work to the mason, but also very little trouble to the brickmaker.

I am using for headers, bricks 8 ins. square. This allows for a perfect, uniform bond, and does not limit you to a header every sixth course only.

This system has especially great advantage in building with hollow bricks, where one is obliged to use solid bricks for headers.

The square bricks are very handy on corners, and I have found that the masons save much time by using them.

I am sure every brickyard will be willing to furnish them along with the ordinary size, as they represent virtually two bricks.

GUSTAV LIEBAU.

MAURER, N. J., Nov. 2, 1897.

PERSONAL, SOCIETY, AND CLUB NEWS.

THE designs of Carrère & Hastings, submitted in competition, have been selected for the new Astor, Lenox & Tilden Public Library Building, New York City; also for the new building for the National Academy of Design, which will be located on Bloomingdale Heights, New York City.

E. R. DUNLAP, architect, has opened an office at 32 School Street, Pontiac, Mich., and would be pleased to receive catalogues.

THE Detroit Camera Club held their annual fall exhibition of photographs in the east galleries of the Detroit Museum of Art, Thursday, Friday, and Saturday, and Saturday evening, November 18, 19, and 20.

THE second annual exhibition of the Society of Western Artists was opened Thursday evening, November 18, at the Museum of Fine Arts, 19th and Locust Streets, St. Louis.

THE Illinois Chapter of the A. I. A. and the Chicago Architectural Club have made arrangements for a course of five lectures by Prof. William Henry Goodyear, of the Brooklyn Academy, on Greek, Roman, and Syrian architecture and archeology. The first lecture will be on horizontal curves and other optical refinements in Greek architecture (including recent photographs of the curves in Sicily and at Pæstum and in the Maison Carrée at Neims). Topics for the remaining lectures will be announced. The lectures will be given in the North Lecture Room (first floor) of the Art Institute on Thursday evenings at 8.15, November 18, December 2, 9, 16, and 23.

A REGULAR monthly meeting of the "T Square Club" was held on Wednesday evening, October 20. This was the first meeting held by the club in its new house. For some time past the club has been without a home, holding its meetings in the offices of the various architects, who have kindly extended their hospitality to their fellow-members. This, however, was always considered a merely temporary arrangement, and the executive and house com-

mittees have been active in their search for suitable quarters, and now feel that a place has been secured as nearly ideal as is possible under existing conditions, having rented on a five years' lease an old stable, the ground floor of which has been sub-let as a carpenter shop, the club retaining the two upper floors for its own use. The upper floor has been converted into one large room 30 by 35 ft., where the club will hold its meetings. Five casement windows extend all across the front and three at the back. A generous brick fireplace has been built at one side, and the walls and ceiling are lined with wood of a dark color. Very little was necessary to be done to this place, with its sloping ceiling and general Bohemian air, to make it a cozy home, and just what all the members have wanted so long.

ILLUSTRATED ADVERTISEMENTS.

THE New York Architectural Terra-Cotta Company send us a view of the Samuel Ready Memorial Library, Baltimore, of which Messrs. Wyatt & Nölting, of that city, were the architects.

The Excelsior Terra-Cotta Company show in their advertisement on page iv, two figures executed by them for the Smith Building, Market Square, Washington, D. C.; T. F. Schneider, architect.

Number 5 of the series of brick and terra-cotta fireplace mantels, which is being illustrated in the advertisement of Fiske, Homes &

SAMUEL READY MEMORIAL LIBRARY, BALTIMORE.
Wyatt & Nölting, Architects.

Co., page vii, is one designed by J. H. Ritchie and modeled by Tito Conti, the drawing being by H. F. Briscoe.

The New Jersey Terra-Cotta Company illustrate in their advertisement on page viii, the new Ninth Precinct Police Station, New York City; John DuFais, architect.

The Probate Court Building, Cambridge, Mass., Olin W. Cutter, architect, is illustrated in the advertisement of the Fawcett Ventilated Fireproof Building Company, on page xii. The illustration shows the building in course of erection.

The residence of Theodore Hooper, Esq., at Baltimore, Md., of which C. L. Carson is the architect, is shown in the advertisement of the Harbison & Walker Company, on page xxv.

Charles T. Harris, lessee of the Celadon Terra-Cotta Company, begins this month, in his advertising page (xxix), a descriptive series of the various patterns of roofing tiles manufactured by his company. A new series of tiles will be illustrated and described each month, and many valuable directions and suggestions regarding the use of tiles will be given.

"Examples of Bond" is the title of a new series of illustrations begun in this month's advertisement of the Gilbreth Seam-Face Granite Company, page xxxviii. It is the purpose of the company to illustrate a number of styles of bond, employing the various sizes and shapes of their seam-face granite blocks.

PERUZZI'S CAMPANILE AT SIENA.

BY W. P. P. LONGFELLOW.

THE southern part of Tuscany, over which Siena used to rule, is curiously destitute of building stone, considering that it lies between the rocky Apennines and the marble hills that border the Mediterranean. But it is a broken, ridgy land, built of marl and clay, and rising into innumerable hills on which the towns are perched, which almost forbids their inhabitants to use building stone, to be dragged over many miles of hilly roads, up long valleys, or over rough ridges, but which furnishes everywhere good material for brick. In medieval times, when roads were bad, the carriage poor, and when every few leagues of the way brought one into a new country, and usually a hostile one, the transportation of stone to a town so placed was almost prohibited. Siena was, till the days of the Renaissance, almost entirely a town of brick. It was built of brick, walled with brick, paved with brick. The Tolomei Palace of gray sandstone is conspicuous among the buildings of the thirteenth and fourteenth centuries by its unusual material. The Grotanelli Palace and the Marescotti, now the Saracini, have lower stories of stone with brick above; but the Palazzo Pubblico, with its wonderful tower, the Buonsignori and most of the older palaces, the famous old fountains, the great churches of San Domenico, San Francesco, the Carmine, the Osservanza, the Servi, and all the older churches, are of brick. Broad, irregular flagstones have displaced the brick pavements in the streets, which are recorded as late as the seventeenth century, but the great central piazza, the famous Campo, still keeps its funnel-shaped brick flooring seamed with radiating gutters of stone, and looking not unlike a huge cobweb.

The brickwork which suited the pliable Italian Gothic of the fourteenth century did not lend itself so easily to the more rigid style of the Renaissance. It is a characteristic but stubborn material which demands sacrifices from the style that is to be embodied in it, or else insists on its right to generate a style of its own. It is contemptuous of fractions of an inch, and even of inches. When it is called on to adapt itself to a style of minutes and modules in which surfaces and moldings are adjusted to centimeters, and perhaps to millimeters, it refuses, and if the designer persists it makes him no end of trouble, and is apt to spoil his work. The use of terra-cotta, the natural adjunct of plain brickwork, did not develop in Tuscany so luxuriantly as in Lombardy, nor did it prevail much in the later style. By the time the Renaissance was brought in bodily from without, the building of the splendid cathedral in marble, with a richness and delicacy of detail before unknown to the Sienese, had revolutionized their ideas of the elaboration of architecture. The artists who brought it, dainty in their choice of material as of forms, naturally chose to execute their works in stone rather than brick. The Piccolomini Palace, and the Loggia del Papa, built for Pius II., the Sienese pope of the Renaissance, set a new fashion of building in stone, which the nobles or communities that built new buildings after these followed as they might, in the Spannocchi Palace, for instance. But the day of Siena's glory was passed. Not a great deal was added to her architectural beauty after the plague of the middle of the fourteenth century had finished the desolation that ceaseless wars had begun. The religious communities which raised a few great churches when the city had somewhat recovered were not rich enough to build expensively. They made structures of brick, which had to be big to accommodate their worshipers, but were for the most part rather rude, with little attempt at finished architecture, at least on the outside.

There is a marked exception, however, in some of the work of Baldassare Peruzzi, which does not aspire to stone but is built of plain brick, yet with a care in design and a certain distinction in detail that are most characteristic of the man, and set his work apart from the rest. Peruzzi was in reality a Sienese, whether he was born in Siena, as seems probable, or brought there an infant from Volterra, as Vasari tells us. If he came, as Vasari says further, from a noble

family of Florence, driven by the quarrels of their fellow-citizens to emigrate to Volterra, this may account for the air of quiet distinction and refinement which characterizes his architectural work, and which, we are told, when all the world was fleeing from Rome after its capture by the Constable de Bourbon, led the Spanish soldiers to take him for some great dignitary in disguise, and to hold him for a high ransom. In Siena he grew up among goldsmiths and painters, in the stimulating atmosphere of the early Renaissance, and by the time he was twenty years old had become a skilful painter. Mural painting was then his work, and having formed his style under the influence of both Sodoma and Pinturicchio he presently drifted to Rome, which had already become the attractive center of all artists. There, falling under the powerful spell of Bramante, he turned to architecture, and became a zealous student of ancient Roman buildings.

Peruzzi belongs to the second generation of Renaissance architects (if we count Brunelleschi, Alberti, and Michelozzo as the representatives of the first, and assume the third to begin with Vignola), among whom are Bramante, the Sangalli, Raphael, Baccio d'Agnolo, Cronaca, and Michael Angelo, and of them all he was perhaps the one who was most thoroughly master of his profession. Whether or not he possessed that power of magnificent conception which enabled Bramante and Michael Angelo to revolutionize the architecture of their day he had no chance to show, for he did not have the great opportunities that fell to them, though his designs, preserved in the gallery of the Uffizi in Florence, and by his disciple Serlio, show power and grandeur as well as skill. He was by his position a successor and follower rather than a leader. His finished works as they remain to us are rather small and simple, excepting the grand but little known Cathedral of Carpi, which, though doubtless his design, was certainly not carried out by him. The Farnesina Villa and the Massimi Palace in Rome are the best known. But there is on them the mark of distinction and of secure control of all the elements of his design that set them apart from the works of his predecessors and contemporaries. Balancing quality against quality, he is deservedly set beside Brunelleschi, Bramante, and Michael Angelo, among the greatest architects of the Renaissance. His works are the first that show a sense of proportion in all their parts, a power of combination, relation, and harmony, and a firmness of profiling and adjustment of detail that make him seem, in comparing him with his fellows, the first thoroughly accomplished architect of the new movement, and one whom in the skill of his profession hardly any of his successors equaled. After he fled back to Siena he was always busy there till he returned to Rome for the last year of his life. The fortunes of Siena had waned, and his work there gave him no great opportunity: so far as it was large in scale it was mostly in modest brickwork. The fortifications of the city occupied him; he planned the convent of the Carmine, and also, it is said, that of the Osservanza outside the city. The charming little courtyard adjoining the house of St. Catharine is his, and various decorative works in the interior of the Cathedral and other churches. The tower which he added to the Church of the Carmine, and which I have to describe here, is a very characteristic example of his qualities, and of his unflagging care even in his most modest work. It is, for all its simplicity, one of the finest of the Renaissance campanili, as it is one of the earliest.

PERUZZI'S TOWER, SIENA.

This tower is a striking piece of really delicate design in brickwork, and bears such marks of Peruzzi's peculiar command of fine proportion in all details as well as in masses, that it would be difficult not to accept the tradition which ascribes it to him. I know of no other piece of brick detail in Siena which can be classed with it. Of the lower part, below the eaves of the nave, I have no photograph, and unfortunately no notes. The upper part, which shows conspicuously above the low roof, consists of two square stories and a low octagonal cupola. Each story is decorated with, or practically consists of an order of pilasters, one at each corner, enclosing on each face a high arched opening, which makes belfry stages of the stories. In the upper openings bells are hung. Every detail is in brick: there is not a line or scrap of stone or of terra-cotta in the whole. Even of molded bricks the forms are few, very simple, and very sparingly used; there are only the cymatiums of the cornices, a quarter-round and a cavetto for their bed moldings, the echinuses of the quasi-Doric capitals, and apparently — I am not quite sure of this — their neck moldings. All the rest is of plain, square-edged brick, yet the design is neither bald nor rude, nor yet inarticulate. All desirable detail is there; the proportion is so finely adjusted, the relief so delicate and yet so firm, the emphasis so well bestowed, that the tower has the effect of a finely treated design in wrought stone, and an air of elegance which it is very rare to find in pure brickwork.

This campanile is worth a careful study in detail; it is to be wished that some trustworthy student would make complete measured drawings of it for the sake of the lessons it has to teach, which can be set forth only by recording with precision the graduated measurements of the detail. The lower story is a little larger in scale than the upper, perhaps a seventh higher, a trifle broader, the pilasters a little heavier, so that it looks more massive, as it ought, while its proportion is in reality somewhat slenderer. The bricks are laid with a precision that would shame most modern bricklayers, and would

seem to indicate that Peruzzi carefully watched the building of the tower, as no doubt he did if he was at hand. The upper pilasters are accurately centered over the lower, their shrinkage being just enough to set back their plinths and the dies of the pedestal course into line with the frieze and architrave beneath. The openings in the upper belfry are not perceptibly wider than those below, so that the shortening of the story makes them appear wider, and the upper story looks accordingly more open. An oval bull's-eye set over each end, perforating both frieze and architrave and interrupting the molding that divides them, looks curiously intrusive, but nevertheless adds a touch of lightness to the upper story that could not well be spared.

Comparisons of the details of the two orders show significant differences. The entablatures are higher than the classic proportion, being about a third as high as the pilasters, which are again heavier than the classic,— a marked departure from the habit of Peruzzi's great predecessors. The upper entablature, really a little lower than that below it, is a little higher in proportion, and the cornice, being designed with block modillions while the other has dentils, is more imposing, and fills the office of the principal cornice, though its dimensions are actually less. Moreover, all the detail of the lower entablature, and indeed of the whole lower order, is lighter and finer than that of the upper, notwithstanding the larger scale of the order itself. The moldings of the cornice are subdivided, and so are also those of the caps and bases of the pilasters. This makes the lower order look a little petty, perhaps, but it enhances the importance of the upper. A curious detail is that while the impost band of the lower order is flush with the pilasters, and so breaks their inner lines, that of the upper is withdrawn from the face just enough to keep the lines there, with advantage to the effect. It looks as if Peruzzi, watching the tower as it went up, had noticed the effect below and had seen how to improve on it above; and it is possible that in the same way he got a lesson of simplification for the upper order.

COURT OF ST. CATHARINE'S HOUSE, SIENA.

The only unsatisfactory details are the keystones. While the motive of each story is the Roman triumphal arch, the brick orders being made heavier than in Roman examples, the arches are proportionally smaller and drop farther below the architrave. The archivolts, therefore, do not touch the architraves, and the keystones are considerably lengthened; but these last being proportioned in width to the span of the arches, are thin and lank, and are only half redeemed by the bands between the panels which occupy the spandrels.

The cupola is adjusted to the tower with admirable grace. It does not parody on a less scale the proportions or motives of the belfry, or echo its function, as is often done; but is composed of different and simpler elements, and so adapted to the upper story as to ally itself closely with it, forming with it, as it were, a single feature, increasing its predominance, and crowning the tower with a singularly graceful outline. It is a low octagonal cupola, a little less in diameter than the square shaft beneath, with square paneled walls pierced by rectangular windows, crowned by a plain entablature, and bearing an octagonal dome. Small scroll buttresses, set against the diagonal faces, fill the angles of the square below at the junction. They are not of beautiful outline, but make the difficult transition from the octagon to the square with unusual elegance. The curves of the dome are circular, making its section a pointed arch and so considerably higher than a hemisphere, but truncated and terminated at the top by an *amortissement* or bulbous finial of ogee curve which is still of brick, but ends in a ball that may be of metal or stone. The eight faces of the dome are broken by plain panels very slightly relieved, the only relieved panels in the tower.

The proportion and subordination of the design are almost perfect, the outlines very elegant, the distribution and adjustment of the detail masterly. There is a gathered richness and focusing of detail in the crowning parts, where it is most effective without sacrifice of the pervading simplicity and without crowding, which is more difficult to achieve than many architectural designers imagine. To be sure, the scheme of design lacks that splendid effect of contrast between the tall, plain shaft and the rich belfry that we admire in some of the Italian campanili, both medieval and Renaissance, in the tower of the Palazzo Pubblico, at Siena, for instance, and at Venice in the Campanile of St. Mark, and in Palladio's Tower to San Giorgio Maggiore (in Isola), but of its type there is none better. We seem to see the master hand of Peruzzi in the free and yet consistent way in which the orders are handled, and especially in the sure and fine gradation of all the measures and reliefs, in the scrupulous adjustment of every detail to its own place and to the whole. Finally, it is a rare example of a classical design skilfully adjusted without compromise to simple brickwork, a material which in ordinary hands has shown itself intractable for such a use.

There is another small work of Peruzzi in brick which deserves mention here for the same qualities that we see in the tower of the Carmine,— the façade which was added from his designs to the old cathedral, called the Sagra, at Carpi. The little old Lombard building, outgrown by the town and standing annoyingly in the way of the big palace which the ambitious Alberto Pio had undertaken to build in the new fashion, was yet too sacred to be absolutly displaced; so Alberto had it razed down to its choir, and sent from Rome a design for a simple brick front which he got from Peruzzi, we are told. It is curious to see that it shows the characteristic motive which Palladio employed later at Venice in the churches of the Redentore and San Giorgio Maggiore, and which is usually considered his property,— the use of two interlocking orders, a high one on pedestals for the nave, and a lower one without pedestals for the front of the aisles. This narrow front has but one inter-columniation each for the nave and the aisles, giving three bays and four pilasters taller and shorter. A wall arch of little projection fills the head of each bay; the old marble doorway, piously preserved beneath, an unfinished pediment at the top of the nave, and half pediments on the aisles, and round panels in the tympanums, finish the design.

THE AMERICAN SCHOOLHOUSE. I.

BY EDMUND M. WHEELWRIGHT.

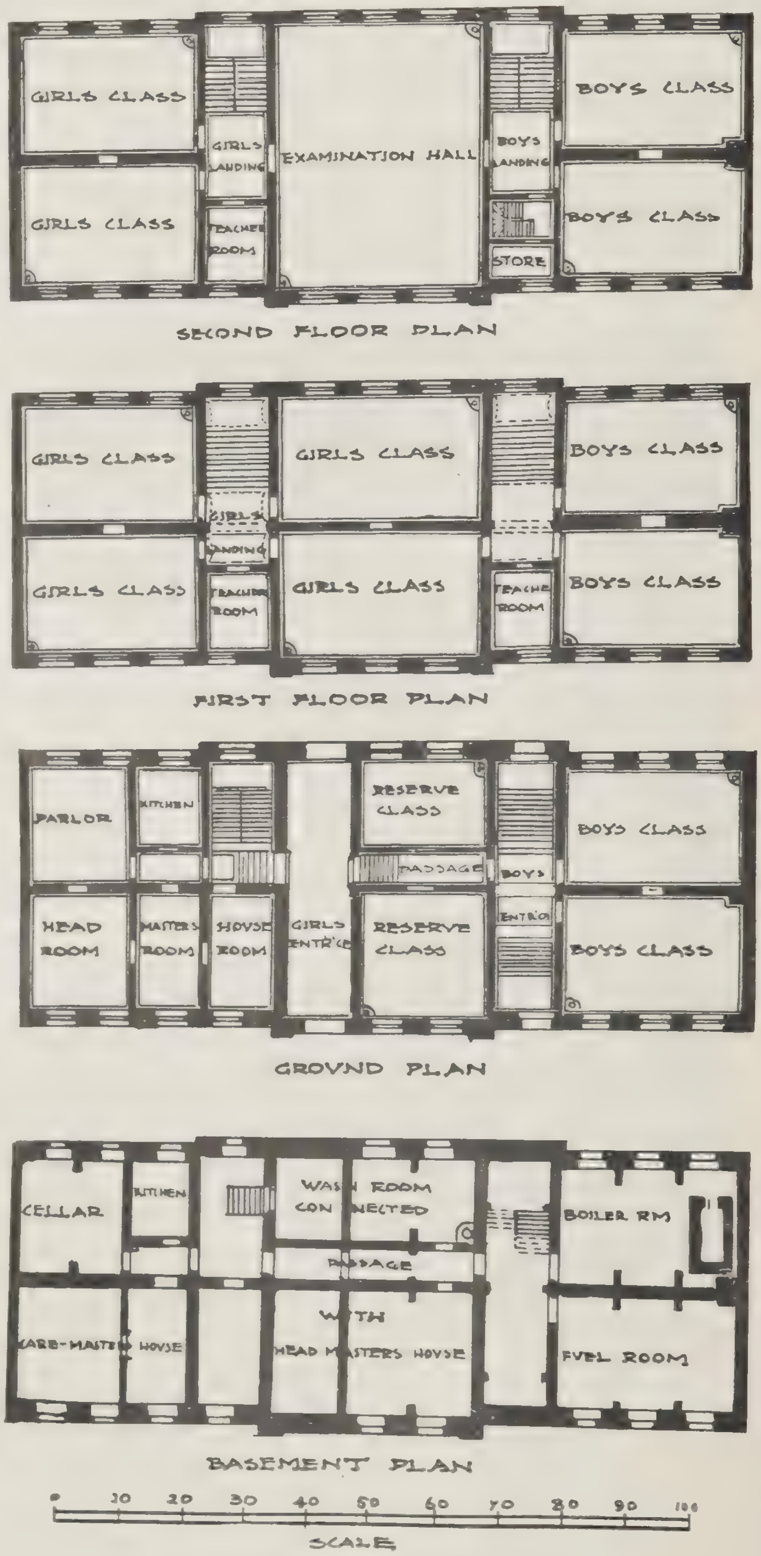
As in all matters pertaining to public education, the Germans have made very scientific study of school planning. While certain considerations which are given deservedly careful attention by us are little heeded in Germany, in important points of planning there is much in the plans of German schools which is immediately suggestive for our own needs.

The system of instruction in France and England differs so widely from that generally adopted in this country that, although points of interest and suggestion are not lacking in particular schools, there is in their plans little of important and general suggestion for us.

The German method of instruction in primary and secondary schools is mainly, as with us, by the separate graded class system. Especial instruction in drawing, music, etc., is given in special class rooms assigned for these studies. but no assemblying of a whole school for purpose of collective instruction enters into the German system. There are, therefore, no large Assembly Halls provided in German schoolhouses. as is the case in American and English schools. Although German schoolhouses have fine and richly ornamented halls, they are not used for the regular exercises, but only on state occasions and for examinations. The Assembly Hall, with us, is not the important feature of the school, as it is in England. We use it only as an accessory to the schoolrooms. In our schoolhouse plans the Assembly Hall is usually placed, as is the German Aula, in the upper story of the building, and both are designed to be of ready access from all parts of the schoolhouse. The different uses of these halls in the two countries appear in their decorative treatment. With us the Assembly Hall has commonly but little more architectural pretension in its fittings than have the schoolrooms; indeed, it is practically but a larger schoolroom, while in Germany the Aulas are often given a rich monumental treatment, as if to be representative of the dignity of the State.

We find, therefore, the German schoolhouse closely resembling in plan the American schoolhouse as it is at present developed; the main consideration of the plan in each being to give conveniently disposed and well-lighted schoolrooms, giving off well-lighted corridors, and a large hall placed in the upper story of the building.

A few points of difference between the customs of the two countries give variations in plan of secondary importance. In Germany, nothing like coeducation of the sexes exists, and consequently in the plans the division between the sexes is made absolute; and this division is not, as with us, almost entirely confined to the basement of the building.



PARISH SCHOOL, BERLIN, PRUSSIA.
From Rolson's "School Architecture."

The importance of good ventilation and freedom from bad odors appears to be more generally recognized in this country than in Germany; consequently, we have in our later schools developed more highly than the methods of ventilating, and we have in our best schools excluded the outer garments of the scholars not only from the schoolrooms but from the hallways. American schoolhouses of the first class are now planned with separate rooms called "wardrobes" or "cloak rooms," one for and immediately adjoining each schoolroom. In Germany, the outer garments are hung on pegs in the schoolroom.

On the other hand, possibly on account of the proverbially bad eyesight of the Germans, the subject of proper lighting of schoolrooms is given more careful consideration among them than with us.

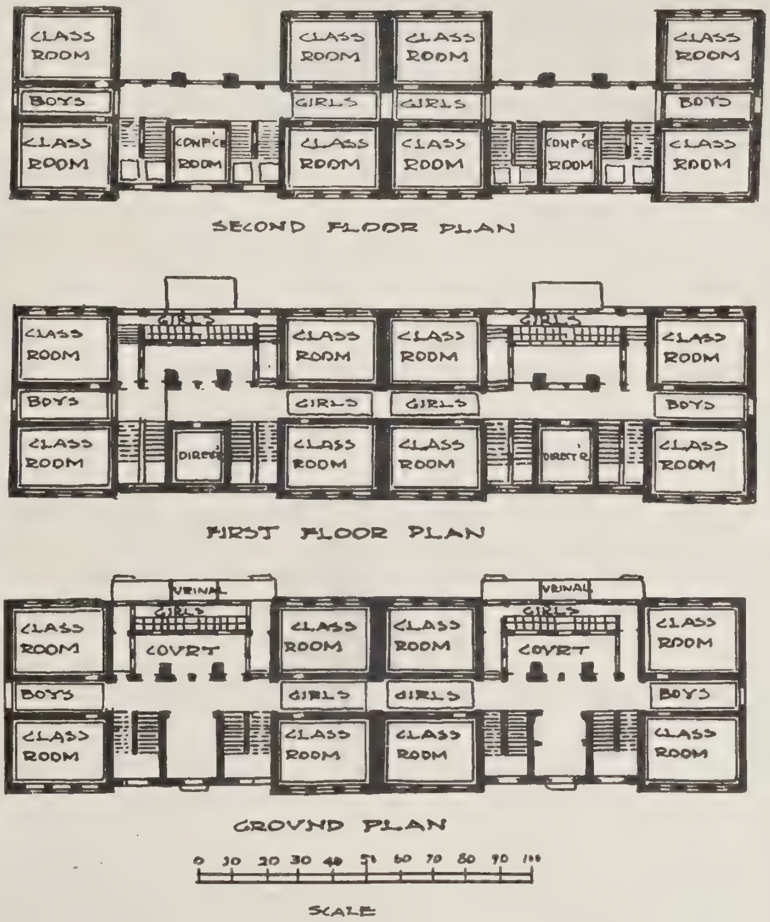
A German schoolroom is either lighted from one side only or from opposite sides. The teachers are not forced to face windows, nor are the pupils subjected to cross light. Schoolrooms are almost invariably arranged so that the principal light comes from the left-hand side of the pupils. But where our classrooms give 12 to 16 sq. ft. of floor surface in a schoolroom to each pupil, in Germany the most liberal area is 10 to 12 sq. ft. for each scholar. This is a consideration immediately associated with the question of proper ventilation, and should not be disregarded in the consideration of the advantages and disadvantages of the schoolroom plans of the two countries.

The schoolroom, 24 ft. (with 12 ft. stud) for primary schools, and 28 ft. (with 13 ft. stud) for grammar schools, generally adopted in this country requires, to give sufficient light to the row of desks next the inside wall, that there should be windows in the wall on the left and in the wall at the back of the pupils. While cross light is disadvantageous for the pupils' eyes, the chief disadvantage of this method of lighting is possible injury thereby to the

teacher's eyes. In no well-planned court room are windows placed opposite the bench, and equally valid objections hold in regard to placing a row of windows, except those with northern exposure, opposite a teacher's table.

It is held in Germany that in a schoolroom lighted from one side only, the row of desks furthest from the windows should not be at a greater distance than once and one half the clear height of the room. While this rule is not, however, followed in all cases, in Germany and France 21 to 22 ft. is the customary width of a schoolroom. The maximum length of a schoolroom in these countries is usually 30 ft. This length is the distance to which the average voice can throw with ease, and it places the pupil in the row farthest from the teacher where writing upon the blackboard behind the teacher's desk can be distinctly seen.

Another consideration in the adoption of a narrow width of schoolroom is the economy of construction permitted by this span as compared with the cost of wider spans; but in Germany, as the number of pupils to a schoolroom, except in the upper grades, is no less and sometimes greater than with us, the pupils in a German school are given a smaller allowance of air space, and do not have the advantage of separate desks such as are now almost universally assigned to pupils in our schools. As far as the scholars' wellbeing is concerned, there is disadvantage to them from cross light, but the great width of the schoolrooms required for the diffusion of light from the windows at the back of rooms gives greater air space per pupil than is given in Germany. It is undoubtedly better to have the light from two opposite sides of the room, or, as would commonly be the case, from the left side of the pupils only. The crowding of fifty-six pupils now seated in grammar schools in schoolrooms 28 by 32 ft. into rooms 22 by 30 ft. is inadvisable.



PRIMARY SCHOOL, DRESDEN, SAXONY.
From Robson's "School Architecture."

The question of adopting a smaller-sized class room in our schools should be considered as one of economy in its broadest sense. A schoolhouse with schoolrooms 22 or 24 ft. in width can be more economically constructed than can one of 28 ft. wide. The eyesight of teachers and pupils would be better conserved in the narrower rooms.

It is for educators to decide whether the lesser number of pupils under each school teacher means greater average progress for each pupil. If so, it is possible that as many pupils per teacher may receive instruction during a term of years under the small class system as under that which now usually maintains. The economy of a system of education would seem to depend not so much upon the number of pupils per teacher receiving instruction upon a given day as upon the average rate of progress of the pupils during a term of years. Smaller classes would admit of greater care in the training of the individual scholar, and under such conditions the rate of progress of the average pupil would probably be considerably increased. Unless the number of pupils per class room in Grammar and High Schools is materially reduced, our schoolrooms cannot be planned according to the most scientific method of lighting, nor can the only weakness of the American schoolhouse plan, as compared with that of Germany, be removed, and consequently no radical improvement can be made in the general plan of our best designed schools. Of course the opportunity for improvement in details of fittings, in beauty of external effect, and in the domestic engineering, is limitless; but as far as general plan is concerned, the module given by the schoolroom for fifty-six grammar grade pupils seated at separate desks prevents no possibility of better combination and arrangement of rooms than have already been made by our best architects.

It is to be hoped that some progressive school board will try the experiment of building a large grammar school designed for classes of forty or forty-eight pupils, and adopt a system which will make rapid promotion in the grades possible. The economy of the small class system can thus be tested on a sufficiently large scale, and for a long enough period to draw reasonable conclusions from the experiment. We should not recede from the system of individual desks and ample volume of air, in which we are superior to the Germans, but we should not rest content with a system of classification which necessitates defective planning as far as light is concerned, if another system is reasonably economical.

If the system of smaller classes should prove to be somewhat more expensive in cost of teacher per pupil per school day, it should be borne in mind that to the credit of the smaller class room is to be placed the interest of the saving on cost of buildings in which the floors, especially in the case of fire-proof construction, are of short span. It would not be surprising if the result of such an experiment would show that the small class system would give as clear gain after duly weighing the other considerations in their economical aspect, the lessened strain on the eyesight of both children and teacher, and the more individual education of the children.

Large primary school buildings for the Elementen Schulen of twelve to fourteen rooms, such as are adopted in Berlin, even if built for small classes, would almost certainly prove to be more economical than the construction of four and six room primary schools. The smaller buildings are more expensive per pupil than larger buildings in cost of land and building, as well as in heating, and, if properly cared for, in janitor service.

Primary schoolrooms, 24 by 32 ft., with a stud of 13 ft. 6 ins., while they would not fully meet the theoretical requirement of width of one and one half times the clear height would be well lighted with windows on one side only and would give seatings for fifty-six scholars. A better lighted primary schoolroom would be one 22 by 32 ft., 13 ft. stud and with desks set six in the width and nine in the depth of the room. This would require aisles as narrow as convenience will admit, say 18 ins. between desks and 2 ft. 4 ins. adjoining outer wall. The loss of two desks necessitated by this arrangement would appear to be a slight objection in comparison with the better lighting acquired.

114.—IMPERIAL GYMNASIUM, VIENNA. THE AULA, OR EXAMINATION HALL.
From Rolson's "School Architecture."

A grammar grade schoolroom 24 ft. 6 ins. by 32 ft., 13 ft. 6 in. stud, while not as narrow as the German theory would require, would give seatings for forty-eight pupils, well lighted from one side only. A better width would be 22 ft., with seatings for forty pupils of the grammar grade. The stud of these narrower rooms may be 13 ft.

To illustrate the effect upon school planning of the adoption of the narrower schoolroom lighted from one side, the floor plans of a grammar school recently designed for the city of Boston, with schoolrooms 28 ft. wide, may be compared with that of a plan with the same distribution of rooms, but adapted for improved lighting, with rooms 22 ft. in width.

In the large German schools living apartments are provided for the janitor, and in some cases for the head master. Such arrangements would appear to be objectionable for all concerned; at all events they do not commend themselves for adoption in this country

Schoolhouses should, if possible, be provided, in addition to the main entrances, with outside entrances to the basement for each sex, and there should never be less than two entrances on first floor. Where the conditions of the building admit, there should be an ample porch provided at the entrance to shelter the early comers who cannot gain admission to the building. The entrance doors should open outward to prevent possibility of disaster in case of fire or panic. The vestibule doors should be hung with double swing spring butts. The main corridors should be of ample width, not less than 10 and preferably 12 ft. wide, and should be thoroughly lighted. Fire protection by tinned doors, making it possible to shut off the staircases on each floor, is a desirable fire and panic precaution. It is very important that there should be such fire doors to shut off the basement, and that these doors should be fitted with spring butts or door checks.

An entrance with runway and storage room for bicycles is to become a necessity in modern schools.

The staircases should be of iron throughout, the treads fitted with rubber mats, or, better, with some one of the recently introduced combined lead and steel treads. Both rubber mats and lead treads should be set in a sinkage cast in the iron tread. The lead treads need not exceed 5½ ins. in width. The staircase risers for primary schools should be 6 ins. high, and in other schools they should not to exceed 7½ ins.; the balusters and posts of iron of plain pattern, and the hand rails of each of plain round section. There should always be wall rails except at platforms.

Staircases are required in Boston to be at least 5 ft. in width. Some authorities consider that such staircases should not be wider than to admit of the comfortable passage of two files of children, each thus having a hand rail; and therefore that they should be but 3 ft. 6 ins. wide, to prevent the possible crowding between the files in case of panic. The excellence of the discipline of our school children has been proved during alarm of fire, and therefore we may safely retain the comfort and convenience of the 5 ft. stairway. There should not be more than fifteen or less than three risers between landings. Landings should be at least 4 ft. between steps. No schoolhouse should have less than two stairways.

Every primary and grammar schoolroom should have a wardrobe or cloak room adjoining it. The practise of using the corridors for cloak rooms is highly objectionable, as the movement of air in the building is naturally towards the schoolrooms. To say nothing of the danger from disease, the mass of clothing, especially if wet, is one of the main causes of the offensive "schoolhouse smell."

The wardrobes should be carefully heated and ventilated, and should have outside windows.

The hat and coat hooks should be set on side walls only, and the top row should be 4 ft. high in primary schools, and 5 ft. high in grammar schools. There should be at least 30 ft. of hanging space in each wardrobe. Every wardrobe should be fitted with a shelf set above the baseboard, or above the upper row of hooks upon which rubber boots and overshoes may be ranged in orderly manner, and not left upon the floor to be kicked about by careless or mischievous urchins. The wardrobe should have two doors, one from the corridor and one to the schoolroom. Four feet in the clear is the least width for a wardrobe.

Wardrobes adjoining schoolrooms are not absolutely requisite for high schools, and considerable economy may be effected in these

BOWDOIN DISTRICT GRAMMAR SCHOOL, BOSTON.
Edmund M. Wheelwright, City Architect.

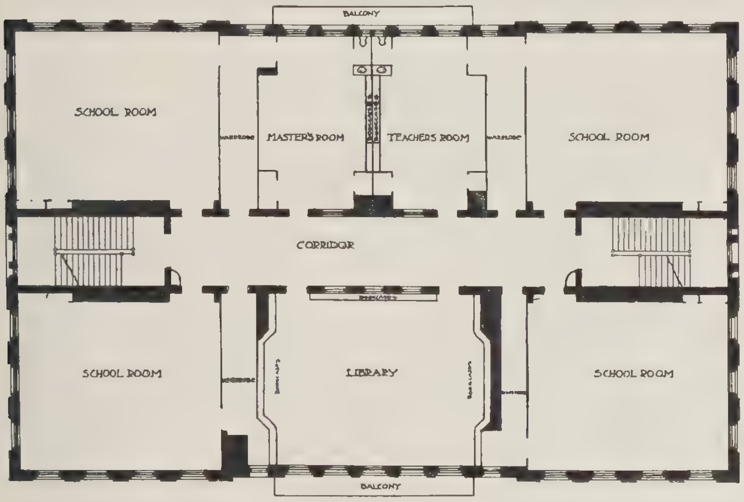
buildings by providing well-ventilated and lighted lockers in the basement adjoining the toilet rooms. These lockers should have panels of stout wire netting, top and bottom, in the doors, and may well be provided with floors and top of wire netting.

As noted above, the standard size of a primary schoolroom, to accommodate fifty-six pupils, is 24 by 32 ft. and that for grammar schoolroom is 28 by 32 ft.; the pupils are seated so that the principal light comes from the left, and to give the requisite diffusion of light in such rooms there should be four windows on the long side, and, unless some requirement of design or plan prevents, three on the other side.

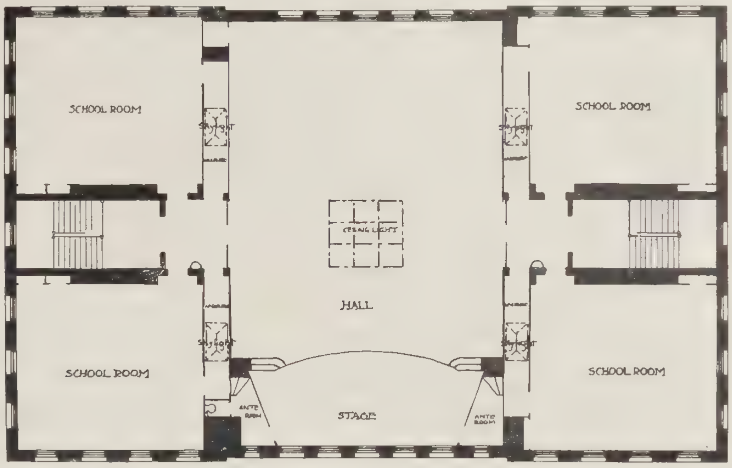
When light comes from the north only, it is not held to be objectionable in Germany to place the pupils with their backs to the light.

The windows should be 4 ft. between jambs, 3 ft. above finished floor, and carried within 6 ins. of the ceiling. The windows should not have transoms, as the transom bar cuts off most valuable light. Narrow windows with mullions are not as good in a schoolroom as wide windows widely spaced. Arched windows should be sparingly used in schoolrooms, and only those of the upper story; when used, the stud of room and height of window should be increased so as to give at least the minimum glass surface noted above. In primary schoolrooms with 12 ft. stud, 32 sq. ft. of light for each window is the minimum requisite size, and that of grammar schoolrooms is 36 sq. ft.

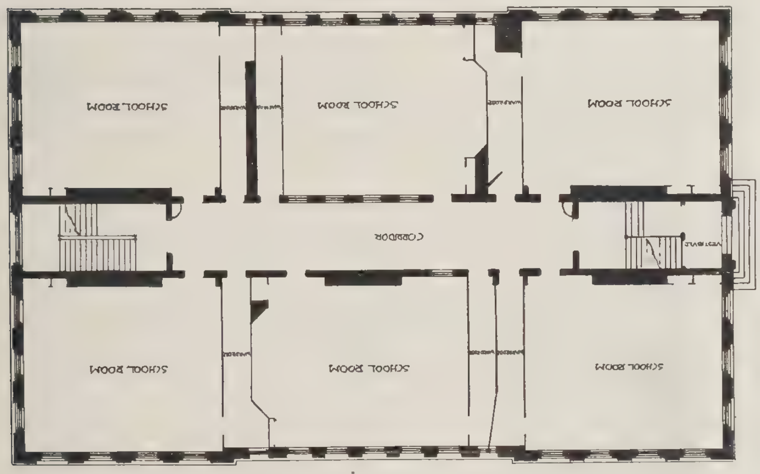
It is desirable that schoolrooms should have double run of sash. The heating system where double sash is used is more effectively and more economically run, and both the dust and the noise from the street is lessened. The expense of double sash is considerable, not only on account of the additional sash, but on account of the greater thickness of brick wall required.



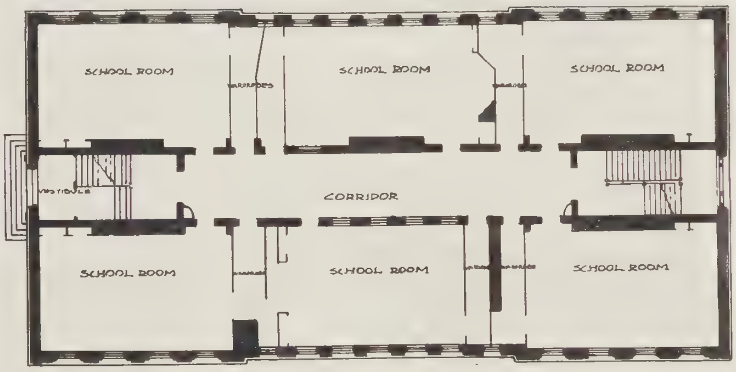
SECOND FLOOR PLAN



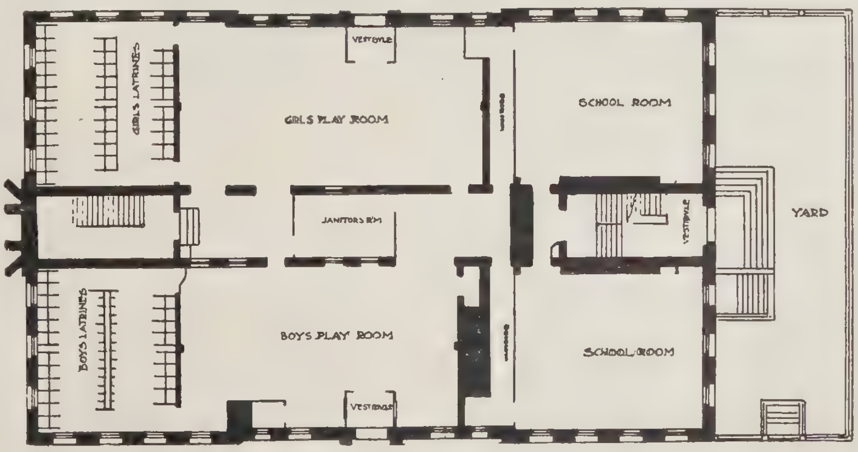
THIRD FLOOR PLAN



FIRST FLOOR PLAN.



PLAN SHOWING NARROW SCHOOLROOM, LIGHTED ON ONE SIDE ONLY.



GROUND FLOOR PLAN.
BOWDOIN DISTRICT GRAMMAR SCHOOL, BOSTON.
Edward M. Wheelwright, City Architect.

Unless the site is on a steep slope it is requisite that all the basement windows should not be less than 4 ft. 6 ins. high.

In lecture rooms, laboratories, and rooms for manual training and cooking, there is no objection to cross lighting, and windows may be placed without regard to the side lighting advocated above.

A platform 10 by 5 or 6 ft. should be provided for the teacher; this should be movable, as many teachers prefer not to have an elevated seat. An ample wardrobe for the teacher, and bookcase set with faces flush with the wall where practical, should be placed adjoining the teacher's desk. The wardrobe should be about 1 ft. 4 ins. in depth, the bookcase 12 ins. Both should have doors and should have cornices on line with that of blackboard.

Architectural Terra-Cotta.

BY THOMAS CUSACK.

THE four Chicago examples of terra-cotta cornice construction furnished by Mr. W. L. B. Jenney, and published in the June issue of THE BRICKBUILDER, have been studied in the light of the description and directions that accompanied them. Construction and commentary were alike interesting, and will, doubtless, prove useful to those for whose benefit they were prepared; and to that end, given publicity in a duly recognized channel of professional information. As an evidence of this we can state that the chief draughtsman of a leading firm of architects — himself a very capable constructor — makes no secret of having adopted the principle contained in one of these examples, for the construction of similar cornices, one of them on a very important fifteen-story building now in progress in New York. Said cornice has already passed through the hands of the writer, in the ordinary course of business; and though it is not altogether what we should have advised, its execution is simple enough, and the result will be found quite satisfactory. We have, however, profited much during a life of some activity, by the interchange of ideas; and as Mr. Jenney — in common with all other successful members of his profession — appears to set some store on the opinions of practical men, we offer, in return, a short criticism and a few suggestions from their point of view. This we shall try to do frankly, but with the deference due to one who, first in many things, was the first to catch an almost prophetic glimpse of the possibilities of the steel skeleton, which, in little more than a decade, became generally accepted, and gives promise of a yet fuller development. Not shrinking from the crucial test of his theory, he at once set about the practical fulfilment of his own prediction, in the outcome of which it may be said — in this case at least — that the prophet is *not* "without honor in his own country."

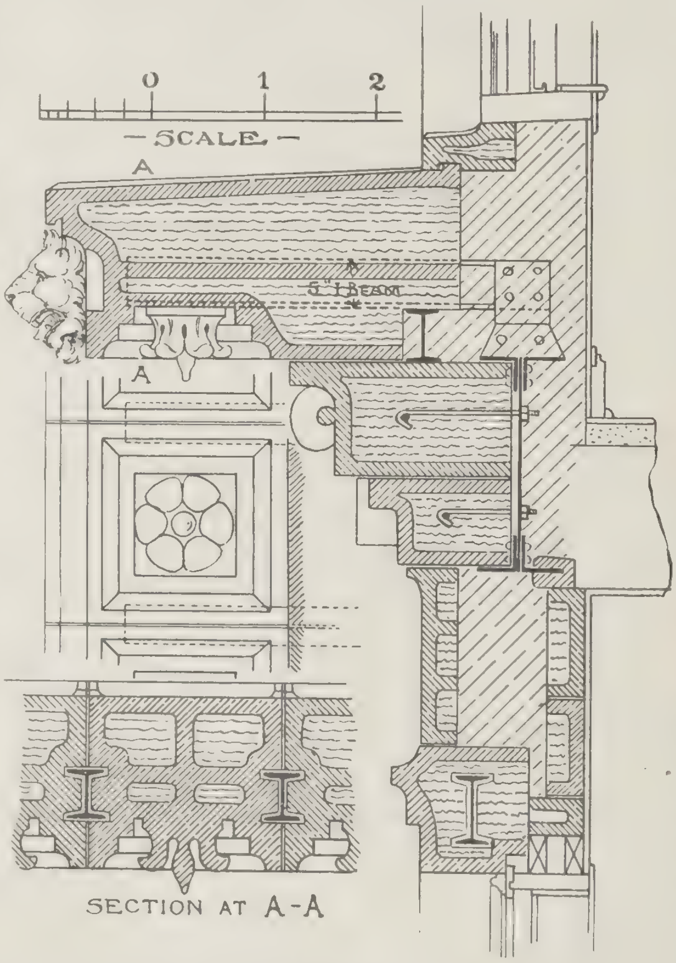


FIG. 42.

His first venture was made in the erection of the Home Life Building, La Salle and Monroe Streets, Chicago, which was begun in 1883, and completed in the following year. In this very building the offices of Messrs. Jenney & Mundy are still situated; and at his desk the venerable pioneer of a successful revolution in the building methods of the world may be found, alert in his movements, quick in his perception, full of interesting reminiscences, and ready to defend the faith that is in him against all comers. We take it for granted that a man such as this will be among the last to deny that as "iron sharpeneth iron, so a man sharpeneth the countenance of his friend."

We would say at the outset that little patience should be wasted on a critic who finds fault with that which *is*, unless he stands prepared to supply the deficiency, and take the risk of showing what he thinks *ought* to have been. This conclusion is reached from a lively appreciation of the fact that: —

> "A man must serve his time to every trade
> Save censure — critics all are ready made."

Acting upon this principle, we take the cornice of the Association Building, La Salle Street, Chicago, and without altering the profile or displacing the girder, rearrange the construction as at Fig. 42. In this way the alteration becomes, to some extent, self-explanatory, and those who wish to follow up the subject will have something tangible to take hold of.

Starting with the architrave, the two courses into which it was divided are now made in one; the blocks being of any desired length up to, say, 2 ft. 6 ins. Should radial joints be required, well and good; they would satisfy the eye of a man who did not pause to reflect, but they would not add strength to work which must be otherwise supported over apertures. Of course the *idea* of strength is worth considering, and there are times when it becomes proper to make needful concessions on purely æsthetic grounds. Of these the present may, perhaps, be considered an instance. In either case provision would be made for a 7 in. I beam, its weight depending upon the width of openings. When the work had been set to line, its soffit resting on a suitable center, the whole of the interstices between iron and terra-cotta should be caulked (from the open chambers at back) full of cement concrete, mixed in the manner recommended by Mr. Jenney. That done, no settlement in the arch or displacement of the blocks could occur. The 12 in. channel and the attached angle can now be omitted and the frieze made as in the original. The dental course and the bed molding above are increased in bond, and made to fit in between the flanges of girder, but otherwise anchored as before, except that the anchors take hold of a ½ in. rod passing *through* the blocks, and are tightened up on a good backing of cement by tension nut.

It is in the cornice itself that the most important change would be made, and that change is radical in principle. The use of hangers is often expedient and sometimes indispensable, but wherever it is possible to introduce a more direct support (as distinguished from suspension) the opportunity to do so should not be allowed to slip. Such an opportunity exists here, and it is our first duty to make minor conditions conform to that fundamental one. The first of these would be to make the block in a single piece, plus the slip-sill; and as it would then be but half the size of blocks that have been made without misadventure, the task in this case would not be a difficult one. The 12 in. I beam used as a fulcrum would give place to a 6 in. retained in the same position and for a similar purpose, with this difference: it would be allowed to rest on the top bed of the course below. The occupation of the longitudinal L's being gone, the cantilevers would be lowered to position shown, and their section changed to 5 in. I's. Finally, if square panels in the soffit were deemed a *sine qua non*, that factor would determine the length of the blocks at about 1 ft. 9 ins.; but if oblong panels were permissible the length of the cornice block might be increased to, say, 2 ft. 9 ins., with advantages that are certainly worth considering. These would consist in a saving of cantilevers, and in reducing the vertical joints to little more than half the number indicated on section (Fig. 42). As to the size of the block so increased, it would still remain less than that of those made (without special difficulty) for the Astoria Hotel, and for other buildings which the

question of space does not permit us to illustrate. Then the protection of these vertical joints; that may be done in a number of ways, some of which were discussed in articles for July and August. Whatever the method, we think, with Mr. Jenney, that the manner should be thorough, and that for the reasons pointedly stated in his remarks. The ways in which cornice blocks and cantilevers may be assembled will be found in the article for September, to which issue, and to those of preceding months, the reader in search of this and similar data is respectfully referred.

At Fig. 43 is shown a cornice of undoubted simplicity, yet giving, when set, an effect that is highly satisfactory, the chenaeu furnishing a particularly bold skyline. It may be seen on the 12th Street elevation of the S. S. White Dental Manufacturing Company's new premises in Philadelphia (Boyd, Boyd & Roberts, architects). The photo, Fig. 44, though taken under certain disadvantages as to the point of view, gives a fairly correct impression of the work as seen from the opposite sidewalk. To obtain adequate projection — in this case 4 ft. 8 ins. plus the lion's head — without adding unnecessary weight to the structure often becomes the turning point between a terra-cotta and a metal cornice. Such was one of the conditions imposed in the design and construction of the subject under notice, and we think the data now presented will show that a fair attempt has been made towards its fulfilment. In Philadelphia the

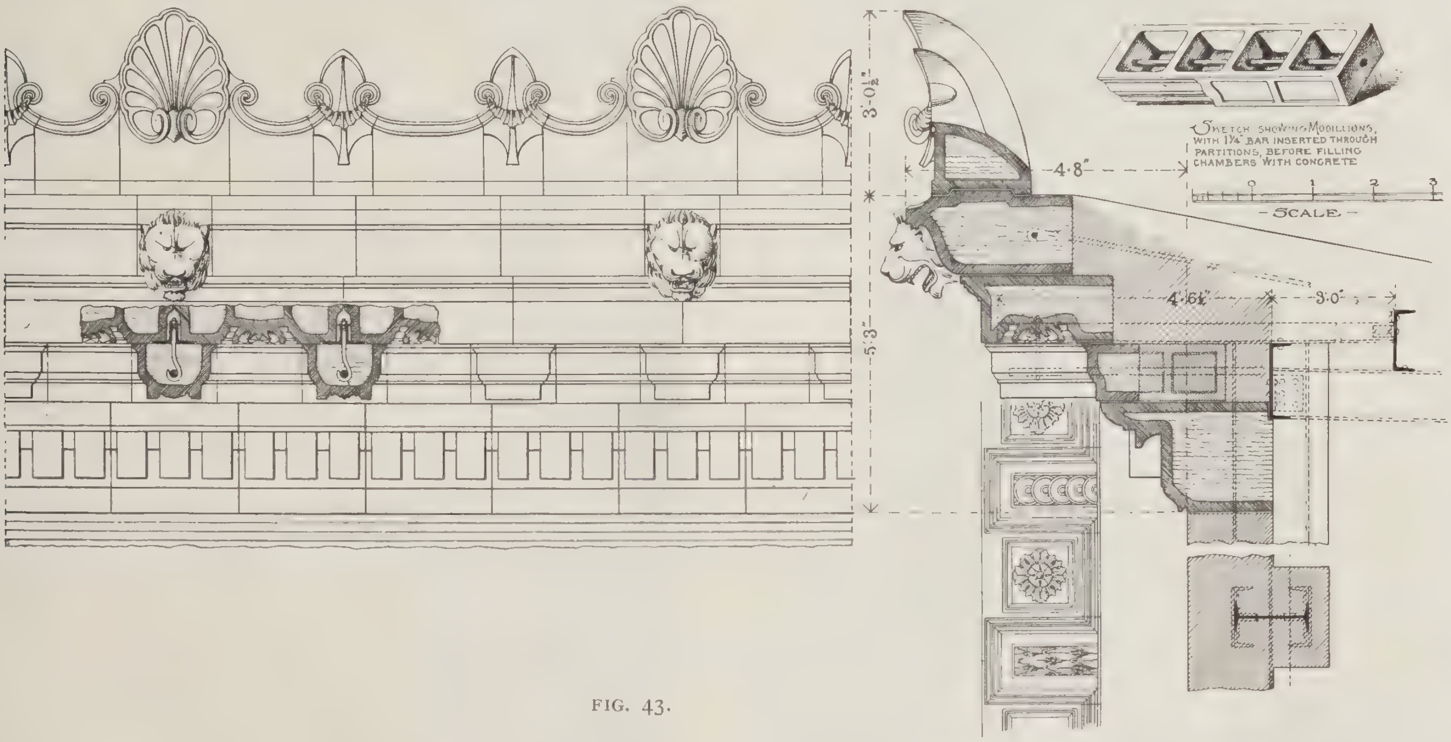


FIG. 43.

building laws are sufficiently abreast of the times to permit of such an attempt being made, without risk of annulment as a foregone conclusion. Had it been in Boston, such a proposal would have been found incapable of execution, by reason of certain belated building laws that have long since outlived their usefulness. Of these, too, we can speak from an unpleasant experience of a few years ago. It is encouraging, however, to know that some concessions have since been made in the manner of their enforcement; but this is not enough: in that respect, at least, they stand in need of a radical revision in the light of progress and advanced practise.

We cannot illustrate the effect of these antiquated ordinances better than by the narration of an incident in connection with a recently erected building in which terra-cotta and brick happened to be the materials used above the first story. The main cornice had a projection of about 3 ft., being supported by steel cantilevers running some distance back into the building and riveted to roof beams. The blocks forming top member of this cornice need not have been more than 2 ft. 6 ins. wide. This would have allowed them a lap of not less than 8 ins. on the bed molding, their weight, in any case, being carried by said cantilevers. But a time-honored law, in which the use of terra-cotta had not been contemplated, enacted long before the steel frame had been thought of, was cited and literally enforced, despite all that could be urged in deprecation of such action. Though originally intended as a precaution in the case of stone, when stone was made to balance on thick walls, and without any iron support, it now received a wider interpretation and was made to apply equally to terra-cotta cornices. This called for blocks with a bearing on the wall equal to their projection, quite regardless of the cantilevers which were spaced on 2 ft. 6 in. centers. The absurdity of all this was pointed out to the powers that be, but to them a city ordinance was like unto "the laws of the Medes and Persians that altereth not." Obstacles of a similar kind were denounced with much fervor some years ago by another distinguished Chicago architect, Mr. Dankman Adler, who, in an able argument published in the *Economist* of that city, inveighed against "official conservatism, self-sufficiency, and self-complacency backed by the letter of the law."

In due time blocks of terra-cotta, one dimension of which was nearly 7 ft. were ordered, but the attempt to make and burn them met with indifferent success. Such of them as had not cracked in the drying and remained intact when taken from the kiln were broken in transit, yet the farce of reassembling and setting the pieces was carried out as per program. Two thirds of that which was ordered to be made in single blocks of terra cotta was, in reality, altogether superfluous. Indeed, we might go the length of saying that it became positively mischievous. For not only does it lie inert and useless; the space it occupies in the wall is but a series of boxes more or less hollow which otherwise would have been built solid in brick and cement; weight in this case being held of high account for its own sake. This, be it observed, resulted from the misapplication of a law which at one time had a specific meaning, but now calls urgently for intelligent revision, with special reference to altered conditions and prevailing methods of procedure. We doubt whether a more glaring anomaly could be found in the building regulations of any city in the Union; if so, it should have the immediate attention of the city dustman.

We are far from saying that in all cases the best possible scheme of cornice construction is adopted. That would imply a degree of cooperation on the part of architect, engineer, and terra-cotta manu-

facturer, the necessity for which is only beginning to be recognized. Neither can we assume that the scheme, after it has been fully elaborated (quite apart from its merits as such), is at all times made the most of in the course of execution. Unfortunately, that is not so; nor could we expect anything so idealistic in the outcome of so brief a period of evolution. It is as yet a new problem, and one for which a solution is being rapidly evolved; but like the language itself, in which we have been said to conceal as well as convey our thoughts, it is not altogether complete. In all the wide domain of human progress there can be no finality. Such improvements as have been made thus far are due to the application of mathematical

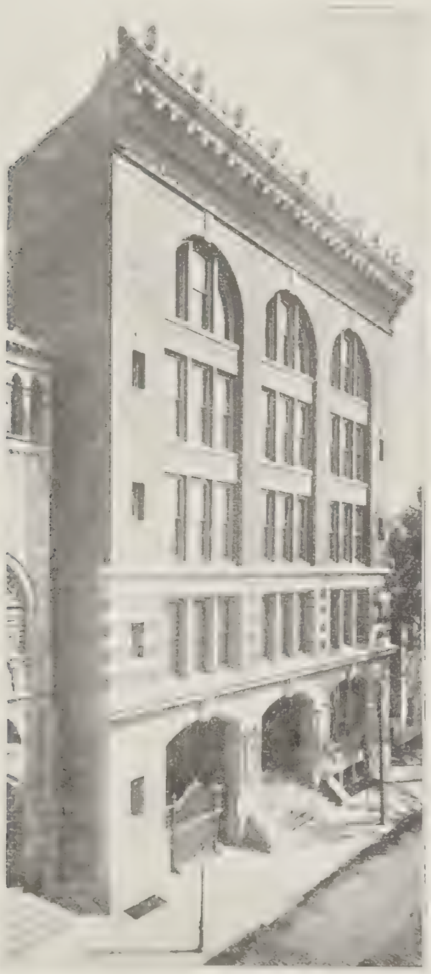


FIG. 44.

principles, of practical skill, and of knowledge such as comes to its possessor by the slow and sure, though not always agreeable, course of experience. Those engaged in it are represented by the architect, the engineer, the clayworker, and finally, the general contractor. Their ultimate aim is, and, indeed, the results already achieved in the construction of terra-cotta cornices are, economy, simplicity, completeness, and absolute security. That much yet remains to be done in these several directions we are free to admit. None the less, however, do we contend that cornices such as have been illustrated and discussed in recent issues of this journal are the logical outcome as they are the crowning triumph of composite construction.

As to the question whether it be desirable or not to introduce brick at all in ecclesiastical edifices, or generally in public buildings, one might, a few years ago, have been anxious to say, somewhat. I trust, however, that the ignorant prejudice which made many good people regard stone as a sort of sacred material, and brick as one fit only for the commonest and meanest purposes, is fast wearing out.—*Street.*

Fire-proofing Department.

THE PRESENT CONDITION OF THE ART OF FIRE-PROOFING.

BY PETER B. WIGHT.

THE question is often asked, "Why should buildings be fire-proofed when it is cheaper, all things considered, to build them otherwise?" This is one of those questions the answer to which is partly within itself and is impliedly in the negative, with many otherwise sensible people. And as long as it is a question of pure economics viewed solely from the investor's point of view, we should not deride and abuse those who view it in that light. When a man's interest is centered in a single piece of property he has no occasion to be public spirited. It is nothing to him whether his building would be a valuable improvement to the town or not. He is only looking for the best percentage on his investment, and takes his chances of fire with the insurance companies. He estimates the cost of his improvement both ways, and reckons his returns both ways. Then he argues with himself how long his building can be kept in good condition, and concludes that it will anyway last through his natural life if it is not burned down, and if it is he can put up another building and get the benefit of the latest improvements. Therefore he estimates to insure his rents also. But the only thing that troubles him is the 80 per cent. clause in his policies. However, he must take some chances, and this is an indefinite one. In addition to this he introduces some of the cheapest features that produce a modification of his insurance rates, finding that they pay from that point of view, and when his building is completed and rented congratulates himself that he has been more successful than some of his neighbors. There are many examples of this kind of investor, and the circumstances are always in his favor.

It might have been said as one answer to the above question: "Because the building law of the locality says it must be fire-proofed if it exceeds certain dimensions." In this answer is also hidden a deeper fact: that the investor, if he finds that the size of his projected improvement comes within this category, must fire-proof his building, willing or unwilling, and mostly the latter. This new investor surveying the field looks at what his predecessors have done. He finds that there are many ways to comply with the provisions of the building laws concerning fire-proof buildings, and still keep within the law. Perhaps he finds that some great building in which no pains have been spared to get the best results is not on a paying basis, and some other one, which is the result of all the cheap materials and devices obtainable, glossed over with much onyx and mosaic, and replete with every comfort and convenience, is in a flourishing condition. All he wants now is an expert able to get around all the expensive materials with cheaper ones that can be made to pass the inspection of the building department, and he is ready to go on with his building. But knowing that he has sought to evade the spirit of the law, he protects himself with insurance, and gets that also as cheap as he can.

Another and somewhat discouraging element that enters into the discussion of the fire-proof building question is of an architectural nature. How many men have asked themselves the question: "Why should I build for all coming time when my neighbor finds it more profitable to build only for a lifetime? I see around me many substantial structures that I admired in my youth, now degenerate and given over to baser purposes than those for which they were erected, and some being torn down to be replaced by monster bird cages. What will my projected bird cage look like forty years hence to the eyes of my children and grandchildren?" He muses on the fleeting fancies and fashions of the present day, which are overriding and displacing many of the best structures of a quarter of a century ago, and wonders why this will not go on forever. He wonders if inven-

tion and improvement will ever cease in our land, and says, "No! The Watchword of Americans is Excelsior!" and then adopts the plan of the most plausible of the many "enterprising" architects who are always thrusting the "latest thing" under his nose. Fashion has conquered his judgment.

This is no fanciful picture. During the last three years a period of financial stagnation prevailing in many of the largest cities of the continent has given those whose energies are usually exerted in projecting public and private improvements, especially in the line of building, much opportunity to mentally speculate on questions which largely concern the architects of the country, and the manufacturers and builders who carry out their plans. They are now criticizing what has been done in years of excitement and occupation which prevented serious thought. They are weighing the results of recent investments in the larger class of buildings, and find many wanting. It is being discovered, or at least asserted, that there has been extravagance. Already some new buildings are projected in which it is sought to depreciate rather than appreciate the quality of materials heretofore used. This is now the general tendency, to which, of course, there are exceptions.

It may be seen in the disposition to cheapen the methods heretofore used in making the interiors of buildings fire-proof. Instead of our past experience resulting in the improvement of old methods, entirely new ones, seeking to supersede the old, seem to find a ready acceptance; and whatever their merits or demerits, they are certainly cheaper methods, and are advocated and accepted largely on that account. The danger of accepting cheaper methods is in the fact that they are generally taken without question as to their quality. They are also taken without being tested by *actual experience.* The only experience to recommend them is found in experimental tests and demonstrations.

The present year has witnessed the only experiences of burned clay when used for fire-proofing purposes on a large scale, and under circumstances calculated to be most disadvantageous to them, that the world has ever seen. Though not unscathed they have done their work, they have fulfilled their purpose. When the crucifiers cried out to the Man of Nazareth, "He has saved others, now let him save himself," they confessed to believe that which they sought to make others think they did not believe. And so the scoffers who can only say that clay fire-proofing has not in a crucial test saved itself are obliged to admit that it has saved the structure of more than one building. It is also a fact that every other pretended system of fire-proofing heretofore used has been an absolute failure when subjected to the ordeal of fire in a large building. Such are the so-called fire-proof buildings erected twenty years ago. Of incipient fires and those that have burned out entire stories without destroying the building the records of clay fire-proofing are a multitude. Many of these have been collected and published in THE BRICKBUILDER, and others remain to be told (see BRICKBUILDER, November and December, 1896). Of buildings with unprotected windows fire-proofed with burned clay, which have resisted the onslaught of fire from adjacent structures that were totally destroyed, may be mentioned the Montauk Block and Schiller Building at Chicago, the latter being of steel skeleton construction, with exterior side walls of hollow tiles.

The experiences of the present year are full of instruction to those concerned in burned clay fire-proofing, and the good result of this will doubtless be seen in the near future. The makers and users have within recent years been too confident in their previous successes, and have neglected to make improvements which are always possible to those who are seeking to make them. There are no defects in the methods of manufacturing and using burned clay that cannot be easily overcome. It is in the selection of the raw materials that there is the greatest field for improvement. After this the most important matter is the method of construction, and the relative quantities to be used for specific purposes.

As far as hollow tiles are concerned, if we have in view the usual systems of many makers which present continuous ceiling surfaces, it is claimed that the chipping off of the bottoms is total destruction of the material from the insurance point of view, even though it has stopped the fire and saved the steel beams. The hollow-tile system thus far used for floor construction is a single system with a double purpose. The systems depending on light metallic supports for concrete or plaster are nearly all double; the floor construction is independent of the ceiling, and the ceiling is stretched below to protect the floor construction. Sometimes it protects the bottoms of the beams, and sometimes they are independently protected. But in all cases it is there to be washed away by water after it has done its work, at which time protection to the floor construction is no longer needed. If the clay system was used on the same principle the results might be different. Up to about seven years ago very many buildings had been constructed with ceilings of fire-clay tiles. In most cases these tiles were attached to wooden floor joists. In many of the fire-proof buildings of Pittsburgh and farther West these tile ceilings were used with steel construction for the highest story. There is only one example east of Pittsburgh, in the American Bank Note Engraving Company's building at New York. In the well-known Horne Department Store, and also in the Horne Office Building at Pittsburg, the highest story was ceiled with clay

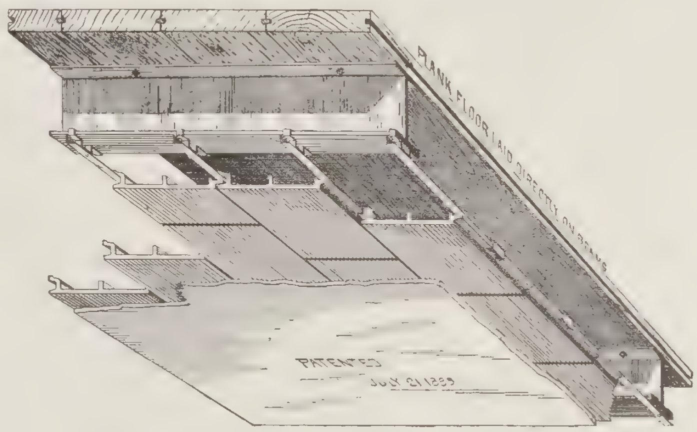


FIG. 1.

tiles, and in each case they were in no way affected by fire from beneath, or by water to which they were also subjected in the Horne Office Building. Another kind of clay tile ceiling was used in one of Ryerson's buildings on Randolph Street, Chicago, where a severe fire raged in the second story two years ago. This has also been described in THE BRICKBUILDER (December, 1896).

In all these cases the tiles were either made in one thickness of material or were hollow tiles that had been split in two after being burned in the kilns. In each the tiles endured the most intense heat and the application of water without falling or cracking. Several methods have been used for making and putting up such tile ceilings with more or less efficiency, but unfortunately they have been driven out of use by cheaper processes. But it has been demonstrated that ceilings of fire-clay tile, and only of tile, will endure tests that no other material will stand, even hollow tile itself. The reason is plain. A hollow tile when it cools in the kiln may still be under a strain in some of its parts, due to shrinkage. This is relieved by splitting it, it having been previously scored for the purpose. These tiles in a ceiling are in a state of rest. Each is independently fastened, and each is free to expand, contract, or move a slight distance. The thinner they are, if of hard tile, the more readily they will respond favorably to the attacks of intense heat or cold water. Everything depends on the way they are fastened; but the difficulties in this respect have been overcome by blind fastenings and overlapping joints. The illustration (Fig. 1) shows a section of one of these ceilings attached to I beams. The brick or tile arches are not shown. Suppose that each I beam was covered on the bottom with heavy porous terra-cotta skew-backs continued under it and a segment tile arch thrown across from skew-back to skew-back. We would have the lightest, most reliable and economical floor construc-

tion with hollow tiles. Now, if hangers are inserted through the crown of the arch, a ⊥ iron can be attached to them running parallel with and between the beams, to which the small angle irons can be attached by iron cleats, as shown in the cut. Thus the tile ceiling would be independent of the beams, giving them increased protection in addition to the skew-backs, and furnishing a non-cracking protection to the whole floor construction. Care should be taken to allow for longitudinal expansion in all the ⊥'s and L's.

Such a construction would be the same in principle, as has been said, as those proposed to be cheaply executed with metallic furring, concrete, and plaster; but carried out in a material absolutely indestructible by fire and water, requiring only a new plaster surface to restore it to its original condition. It is not to be expected that it would suit the man who seeks to get around the provisions of the building laws, but it would be demanded for the highest class of buildings wherever the best of everything is sought for.

NAKED STEEL CONSTRUCTION SEVERELY TESTED.

A FIRE of extraordinary severity and destructiveness occurred in Detroit on the 7th of October. It destroyed the Detroit Opera House and five adjacent buildings of ordinary construction, two of them fronting on Gratiot Street in the rear of that on which the opera house fronted. In addition to these last was another building adjoining them and situated only 20 ft. from the rear wall of the opera house, occupied by the H. R. Leonard Furniture Company, and designed by Rogers & McFarlane, architects, of Detroit. This building was 26 by 110 ft., and ten stories high. Besides the street front on Gratiot Street, its side, 110 ft., fronted on a 20 ft. alley, and an alley 20 ft. wide separated it from the opera house. The whole building was of riveted steel construction and had girders and columns through the center. The front was of brick, but the side and rear were covered on the outside only with hollow building tiles. Curiously, while the whole skeleton was steel, all the floors were of mill construction. It was in open lofts and stocked with furniture from top to bottom. The only attempt at fire-proofing was to cover the columns and girders with fire-clay tiles. Everything combustible in it was completely burned out, and it must have made a most intense fire. But the entire steel skeleton remains standing, with the front wall and about half of the tile wall on the alley. The columns and girders are of course standing with the frame. The covering of the columns and girders, which were certainly more exposed than any other part of the frame, may have been the means of preventing a total collapse. The amount of damage to the steel work has not yet been ascertained. The only wonder is that the burning of the combustible floors did not bring down the whole structure. There is nothing remarkable in the falling of a large part of the hollow-tile covering on the exterior, for the unprotected steel must have been greatly expanded and warped by the intense heat on the inside. There were no fire shutters on the rear. This experience only speaks well for riveted steel structures, but the whole may have to be taken down if it is warped out of shape as a whole, or in any of its details.

FIRE-PROOF BUILDINGS.

SINCE the decline within the last few years in the price of iron and steel, accompanied, as it has been, by the breaking up of what was once known as the steel beam trust, the number of fire-proof buildings that have been erected in the large cities of this country has greatly increased. The adoption of the so-called skeleton form of construction is a method which permits of the utilization of space to an extent which would have been found impossible if the old methods of building had been continued. As it is now, it is estimated that a fire-proof building can be put up at about half the price that would have been required to pay for the construction of such a building eighteen or twenty years ago, while, as compared with the ordinary non-fire-proof building, one of these modern fire-proof structures is said to call for an outlay not greater than 10 or 15 per cent. more in amount. This slight margin of increase is more than made good by the increased space obtained, as referred to above, and also by the fact that when once put up a building of this kind requires but a small expenditure in the way of repairs, and possesses the merits of indefinite durability. But beyond this there is also the fact that the insurance rates charged against fire are so much lower in the case of fire-proof structures than those which are not built in that manner, that the saving forms a considerable return in interest upon the extra money spent in the work of construction.

But while a building may be classed as fire-proof — and this classification, unfortunately, has been given to a great many structures which do not deserve to be put in such a category — no form of building can offer absolute immunity against the destruction by fire of the inflammable contents which may be stored within it. Our building laws have put no limit upon the area which may be covered by a so-called first-class or fire-proof building, and it is obvious that if such a structure extends over half an acre or an acre of ground, and has each of its floors filled with combustible merchandise, a fire taking place and obtaining great headway on one of these stories may in itself cause a large loss, even though the building itself may not suffer material damage. This was the experience in the conflagration which took place in Pittsburg about a year ago. The fire started in a building of ordinary construction, but the flames were carried by the current of air against the unprotected glass windows of a fire-proof building on the opposite side of the street. The result was that the merchandise on each story of the latter building was set on fire and completely burned up. The structure was in certain ways faulty, a fact which was brought out by the hard test of a hot fire. But the main structure of the building stood firm, although its entire contents were converted into ashes.

A few weeks ago an alleged fire-proof building, a storage warehouse, took fire in Detroit, and in this case the contents were entirely destroyed, while the building itself was damaged to an extent which may require almost entire reconstruction. In this instance, the fire-proof qualities possessed were those of name rather than of fact.

But in view of the presumable loss which might happen to the contents of our fire-proof buildings, when these are used for the storage or sale of inflammable material, it is not unlikely that some restriction should be placed upon the extent of undivided areas. With a building of second-class or ordinary construction the limit of area is 8,000 ft., a space which, if filled with inflammable merchandise, is quite large enough, when on fire, to furnish hard work for a fire department in its efforts to extinguish the flames. In view of the fact that the tendency of the times is in the direction of fire-proof construction in this city, and in view, furthermore, of the circumstance that it is well to take precautions against a known danger in advance, it would be prudent to put some limit in the way of dividing fire walls in fire-proof buildings which will be erected in the future.

So far as office buildings are concerned, no limitation is required, for the reason that these are of necessity divided by fire-proof partitions into relatively small compartments, while the contents of these is hardly ever of a character to offer the materials for a hot fire. The same statement holds true of apartment houses and hotels, which are also cut up by interior fire-proof partitions, so as to impose a check to the quick spread of the flames. But in the modern warehouse it is often thought desirable to have a large undivided area, and these areas are commonly filled with considerable quantities of inflammable merchandise. If the regulations of our building laws were such that these floor areas could not extend over a greater space than 10,000 sq. ft., and where a store of three or four times this area was required, it would need to be divided from the ground upward by solid fire-proof partitions, cutting up the building into sections of not exceeding 10,000 sq. ft. each, it is probable that the convenience of trade would not be greatly interfered with, while the construction would be such as to make it possible for the fire department to hold a fire that occurred within the limits of the floor of a single section, thus making a conflagration impossible.— *Boston Herald.*

Mortar and Concrete.

LIME, HYDRAULIC CEMENT, MORTAR, AND CONCRETE. VIII.

BY CLIFFORD RICHARDSON.

THE ROSENDALE CEMENT INDUSTRY.

PHYSICAL TESTS OF NATURAL CEMENTS.

THE strength, when determined under similar conditions in the laboratory, is a valuable indication of the character of a cement and of the effect upon it of variations in its chemical composition and physical properties. Each kind of cement is made into test pieces in the way most favorable for developing its best qualities, the fineness of grinding, the amount of water necessary to make the mortar, and the time required for setting being observed. At intervals the strength, either tensile or compressive, is determined.

Examinations of this kind have been made by the writer in the last few years of most of the well-known brands of natural cement in use in the concrete base of asphalt pavements over a large portion of the United States. The results are given in the following table, supplemented, where some of the long-time tests are incomplete, by those of other investigators which seem comparable. It is impossible, however, to use the tests of the manufacturers themselves, and of many city engineers as a means of comparison, owing to the methods employed, which are quite different from those in which the test pieces are made with dry mortar and of sufficient density. It has been possible, however, to use some of the results of the excellent tests made in the office of the Inspector of Asphalt and Cements of the District of Columbia, and some of those of the cement testing department of the Board of Public Works of Philadelphia, which are the only ones available which are made under the same conditions as those of the writer, upon which the table is based. The results of some long-time tests of Western cements carried on under the direction of the city engineer of Minneapolis, from 1888 to 1894, are also introduced in parentheses, although only comparable among themselves.

PHYSICAL TESTS OF AMERICAN NATURAL CEMENTS, TENSILE STRENGTH, FINENESS, ETC.

BRAND.	Fineness.			Water in Mortar.		Set.		Neat, tensile strength, pounds per square inch.						Two parts crushed quartz.				
	200	100	50	Neat.	Sand.	Initial.	Hard.	1 day.	7 days.	28 days.	3 mos.	6 mos.	1 year.	7 days.	28 days.	3 mos.	6 mos.	1 year.
Rosendale, best, N. Y.	10.	7.	2.	28.	12.	20′	35′	100	206	400	450	457	500	80	150	250	370	450
Rosendale, average, N. Y.	24.	12.	3.	28.	14.	20′	35′	75	150	300	325	375	460	45	130	210	270	340
Buffalo, N. Y.	32.	24.	6.	26.	12.	18′		80	240	310	(305)	(290)	(346)	80	152	(115)	(103)	(97)
Akron, "Star," N. Y.	12.	7.	2.	26.	12.	8′		112	300	320	(317)	(364)	(369)	108	230	(152)	(149)	(115)
Milwaukee, Wis.	18.	10.	2.	30.	13.	45′	80′	120	160	234	338	(327)	(372)	60	80	(135)	(152)	(156)
Utica, Ill.	24.5	15.	4.	32.	14.	15′	35′	190	249	336	(257)	(242)	(259)	118	140	200	(122)	(134)
Louisville, "Anchor," Ky.		24.	11.	31.5	13.5	22′		110	222	310	(327)	(368)	(416)	98	152	(110)	(144)	(161)
Louisville, "Speed," Ky.	24.	16.	10.	33.5	15.	5′	10′	180	248	394				72	164			
Sellersburg, Ind.		27.	12.	30.	13.5	27′		40	60	320				30	130			
Fort Scott, Kans.	12.	4.	trace.	37.	14.	10′	22′	52	100	160				36	86			
Double Star, Kans.	9.	3.	1.	38.	15.	8′	36′	116	210	305	276			114	256	398		
Mankato, Minn.	31.	9.	1.	30.	14.	45′	65′	188	238	346	(259)	(280)	(319)	112	160	(120)	(126)	153
Union, Penn.		7.		28.	12.	33′		170	230	375				150	250			312
Improved Union, Penn.	30.	15.	3.	28.		16′	43′	140	219	314	324	397		145	231	296	359	400
Round Top, Md.		15.	8.	32.	14.	30′	50′	100	250	300	410	446	526	122	255	342	387	515
Cumberland, Md.		19.		32.	14.	30′		100	300	375	371	393		156	297	356	350	438
Cumberland and Potomac, Md.	30.	17.	4.	32.	14.	32′	63′	100	300	315	371	393		188	225	403	397	436
Antietam, Md.		7.		32.	15.	30′		65	146	300				70	124	162	226	232
Shepherdstown, Md.		14.		30.	14.	20′		70	160	300				106	210	265	281	366
Anchor, Penn.		10.	1.5	25.	13.5	75′		150	300					90				
Milroy, Penn.		19.5		30.	13.	20′		50	170	400				70	200			
Utah		13.6	3.5	32.	14.	8′	41′	80	204	280	390			52	230	336		

TESTS OF COMPRESSIVE STRENGTH.

Pounds per square inch.

Brand	Buffalo, N. Y.	Akron, "Star," N. Y.	Louisville, Ky.	Milwaukee, Wis.
Neat: —				
7 days	997	1325	1737	913
28 days	1300	2812	2795	1457
Two parts quartz: —				
7 days	700	700	500	506
28 days	980	1300	1065	822

	Fort Scott, Kans.	Double Star, Kans.	Mankato, Minn.	Utica, Ill.
Neat: —				
7 days	769	1072	1663	1538
28 days	1256	2402	2288	1972
3 months		3155		
Two parts quartz: —				
7 days	417	988	575	1075
28 days	680	1470	834	1450
3 months		2718		

	Average Rosendale.
Neat: —	
28 days	1737
Two parts quartz.	
28 days	614

An examination of the data in the table shows that there are very decided differences to be noted in connection with the fineness of grinding of the samples of the different brands, the amount of water necessary to make the strongest mortar, the set and the tensile and compressive strength at different ages. It would also be found, among a large number of tests of the same cement, that there are often considerable variations in many of the brands themselves from time to time and from year to year, depending on changes in the character of the rock and in the manner of burning. For comparative purposes, however, the results which have been selected are sufficiently illustrative to show what the general differences are in the nature of our natural cements when at their best.

These differences must be considered in the light of our previous information as to the chemical composition and density of the several cements and of our actual experience with them in their practical applications.

Fineness. How fine a cement may be when put on the market is primarily purely a question of the care bestowed on grinding, but under ordinary circumstances it is dependent, to a large degree, on the hardness of the burned stone. The facilities for grinding are much the same at all cement mills, and at but few of them, at least hitherto, has sifting and care in grinding been practised. In the manufacture of the best Hoffman Rosendale of New York scalping or sifting, as well as grinding, is carried on, with the result that this cement is extremely fine, and yet there are some other cements which are softer and as satisfactorily ground without scalping.

The importance of fine grinding appears from comparative tests of sand mortars made of cement from which the coarser particles have been removed, and of that containing a considerable portion of coarse material, which, by itself, has little or no hydraulic activity. These tests show that, other things being equal, the finer the cement the stronger are the sand mortars made with it, at least

in the ordinary proportions and at early stages, although in the neat form, the mortar, made with coarse cement, may produce a test piece stronger than that made with the finer material. On this account as our best natural cements are now furnished of such a degree of fineness that less than 10 per cent. is coarser than will pass a 100 mesh sieve, it is important that the coarser cements should not be accepted for use, at least at the same price as the finer.

Fineness is undoubtedly an element of importance, although probably not as much so as in the case of Portland cement, which is used with larger proportions of sand. Fortunately the manufacturers are beginning to appreciate the fact that the improvement that they make in their cements by attention to this detail repays them by the higher test which the finely ground material will give, and the readier sales it will command where they are made to persons who understand the importance of fine grinding and who test their cements carefully before using. Upon those who pay little or no attention to the character of the cement which they employ such a refinement may, no doubt, be thrown away.

Set. Natural cements, when made into mortar with the smallest amount of water, set in from a few minutes to an hour or more. There is a wide difference in this respect, although, as a rule, natural cements are quick setting. The variations are due to the composition of the rock, the extent of its calcination, and the degree to which hydration of the finished cement has been carried. Much high-grade cement may, when first burned and ground, heat when mixed with water and set too rapidly, but when properly hydrated by sprinkling or steaming the burned stone or by storage, it may be made to set slowly and give satisfactory results. The lime cements are usually the quickest in setting unless hydrated, but they are equaled in this respect by many magnesian cements, too rich in carbonates. Very slow setting is unusual when cements are freshly burned. When found it is due to weathering, air slaking, and age, or to deficiency in the proper proportions of lime to silicates.

Normal natural cements, satisfactory for use, when mixed with a small quantity of water, it appears, begin to set in from fifteen to thirty minutes, and are hard set, that is to say, not easily indented by the nail, in about forty-five.

The time required by the same cement, when employed under varying conditions, may vary very much. The more water there is used in making a mortar the slower the set will be. The warmer the water and air the quicker the set; and the more humid the surroundings, and the more excluded the mortar is from the air, the slower it will set.

On this account quick-setting cements must be mixed with more water than slow. They are also frequently in demand where the surroundings have a tendency to delay setting.

Water. The amount of water necessary to make the strongest mortar with each cement for comparative tests is variable. It is commonly expressed in percentages by weight. This is, however, to a certain extent deceptive, as the relation is one of volume.

The variation in the amount of water required is due to several causes,— the degree of fineness to which the cement is ground, the specific gravity of its particles, its volume weight or density, and to its chemical composition. With considerable coarse material the voids in the cement are smaller and the volume of water required for a mortar less. When one cement has a higher specific gravity than another the same volume percentage of water will mean a smaller weight per cent. in the first case. For instance, 300 parts by weight of a cement having a specific gravity 3.00 might require 84 parts by weight of water to make a mortar, while 265 parts by weight of a cement, having a specific gravity of 2.65; but an equal volume with that of 300 parts of a specific gravity of 3.00, would require the same volume of water, or the same amount by weight, 84 grams, but in the first case the per cent. of water by weight would be 28, and in the second, with the light cement, 31.7, although in each case the volume was the same.

The chemical composition of a cement has probably the greatest influence upon the amount of water necessary to make a mortar. Depending upon the quantity of water necessary to hydrate and combine with certain compounds the amount necessary in addition to make the mortar plastic will vary. The cement made at Fort Scott, Kans., requires much more water than any other natural cement to properly temper it. This is due to the fact that on its addition a portion of the water is at once taken up in chemical combination by the cement, leaving only an ordinary amount to act in the physical operation of making a mortar. The magnesian cement of Western New York requires but 26 per cent. of water and the best Rosendales but 28. Here there is not the same immediate demand for water to combine with the cement chemically, and so a smaller volume is sufficient to make a mortar. The quicker setting a natural cement is the more water it requires, as a rule, as the quick set is merely an evidence of active chemical change which requires and ties up additional water.

The difference in the volume of water required by a natural and a Portland cement also illustrates the effect of difference in composition in the amount of water requisite for making a mortar. A good Portland cement of specific gravity 3.15 requires 21 per cent. by weight of water to make a mortar. 315 parts by weight would, therefore, require 66.15 parts by weight of water. The relation of the volume of the particles of cement to that of the water would be as 100 : 66.15. A Rosendale cement of specific gravity 3.00 requires 28 per cent. by weight of water or 84 per cent. by volume of the particles of cement. The Rosendale, therefore, requires over 17 volumes more of water to the 100 of solid cement on account of its different chemical composition and aside from the difference in density.

Another difference in the behavior of cements towards water is the variable amount of working mortar that different kinds of cement require, owing to differences in the speed with which water acts upon them. Some quickly make a smooth and plastic mass, while others require a more prolonged kneading to bring about the proper hydration of certain constituents.

In the practical use of natural cements these peculiarities have their influence and will be noted later.

Strength, Tensile and Compressive. The results of tensile tests of cements given in the preceding table are of representative samples of the best grade of each brand as far as they have come to our attention and for the strongest test pieces which care and experience can make under the most favorable condition. Under these circumstances the tensile strength appears to be, in almost all cases, satisfactory, and it seems that many of the brands attain a strength of over 100 lbs. per square inch in the form of sand mortar, 2 to 1, at the age of seven days, and may be expected to reach this standard at all times. Some brands do not reach this strength at seven days but gain it later, while a few do not continue after some time to increase in strength in the proper ratio. These peculiarities may profitably be examined by comparing the results of the tests with the chemical composition, and what we know of each brand in practical work and other properties of the cements.

Typical Natural Cements. As types of high-grade natural cements of the magnesian and lime classes the Hoffman Rosendale and Round Top cements may be selected. After learning to what their valuable properties are to be attributed it is then of interest to compare the other cements of the country with them, and to learn to what the differences in the latter are due.

Rosendale Cement. Using this term as applied properly to the product of Ulster County, N. Y., alone, we have seen that this cement, of which Hoffman Rosendale has been taken as one of the highest grade brands, is made from a dense rock, that it has a high specific gravity and is finely ground. In tensile strength it does not equal some other cements soon after it has been made up, but with age it increases in strength slowly and continuously without expansion, and is not to be excelled by any of the cements of its class when a year or more old. An examination of its chemical composition shows that its excellent quality must be attributed to the fact that it contains about 15 per cent. of alumina and iron oxides repre-

senting an abundant supply of the necessary clay, that the combined silica reaches a satisfactory figure, and that the magnesia is not excessive for a magnesian cement, being about 14 per cent. It appears that the rock is lightly burned, as shown by the uncombined silica and silicates, the cement is very finely ground and, both in the testing laboratory and in construction work, has proved itself for years such a satisfactory article that it may be fairly used as a standard with which to compare other cements. The color of this cement is a deep and dark brown, decreasing in intensity with the decrease in the amount of silicates in the rock from which it is made.

Round Top Cement. Although this cement is known only in the limited markets, reached from the place where it is manufactured in Maryland, it is such a perfect type of a natural cement, nearly free from magnesia, that it has been selected as the standard of its kind. An examination of its physical and chemical properties and a comparison of them with those of the best magnesian brands is instructive and shows to what its valuable properties are due.

It is of only ordinary fineness but of considerable density. It sets in about the same time as many Rosendale cements, but it sets harder and gives much more rapid returns in strength both neat and with sand soon after being made up, both in test pieces and on the work. It is not exceeded in strength by any natural cements after the lapse of considerable periods of time, though equaled, of course, frequently by some other brands of its kind. It is not as plastic as Rosendale cement and requires more water to make a dry mortar and more working to make a smooth one. It does not lose as much in initial strength on addition of excess of water nor is it affected as much by cold, and can be used in winter weather where a magnesian cement would fail. It is particularly suited for concrete work, where centers are to be drawn, owing to its great initial strength and rapid gain. The valuable properties of this cement must be due, as in the case of the best Rosendale cement, to the satisfactory proportions of its various components. The combined silica, in an average sample, reached 21.68 per cent. and the alumina and iron oxide 12.48 per cent., corresponding to very similar proportions in the Hoffman Rosendale, but the magnesia fell to but 2.86 per cent. The absence of the magnesia gives a very different character to the cement, its property of acquiring great initial strength, and one which distinguishes it sharply in its working from most magnesian material.

As taken from the kiln the ground rock or fresh cement is apt to be hot and quick setting, but on sprinkling the burned material with a small amount of water before grinding this difficulty is removed.

In color this cement is a medium between the dark Rosendales and the light Western cements, which may be described as a light brown shading into buff.

SAND CEMENT.

THE engineering public is always interested in the improvement of cement. One of the most likely directions for such improvement at present seems to be the use of sand cement. Concrete is a mass of coarse stone or gravel whose interstices are filled with sand, which in turn has its interstices filled with cement. The finer we grind the cement the more completely is the surface of each sand grain covered with it, and the stronger the resulting mass. Now let us go one step further and we have sand cement. Let us take a mixture of, say, one to one of Portland cement and pure sand (silica sand), and regrind this mixture into an impalpable powder, in which the cement gets ground very fine and the sand itself is as fine as ordinary cement. If we mix this sand cement in the proportion of, say, one sand cement to three ordinary sand, we obtain a mortar nearly as strong, and, indeed, some claim, fully as strong, as an ordinary mixture of one cement, three sand. — *Prof. Cecil B. Smith, in Canadian Engineer.*

The Masons' Department.

THE WAY TO AWARD SOME BUILDING CONTRACTS.

MOST buildings at the present day are planned and constructed on what might be called a mercantile basis, the dominant idea being to obtain the greatest possible results with the least possible expenditure of money; in fact, in a large proportion, if not a majority of cases, it is necessary to cut down the figures which have been obtained in competition, in order to make the two ends meet. But while such is the ordinary and every-day experience, there is, fortunately, a growing demand for well and thoroughly built buildings, particularly in the cases of the best domestic work, where the owner is willing to pay a fair price for what he receives. In such instances, if the architect desires to take advantage of his opportunity, he must certainly adopt a different policy in obtaining estimates and awarding the contract from the method usually pursued.

The unfortunate and inevitable consequences of close competition in awarding building contracts have been already pointed out in these columns, and it naturally follows, if work can be given out on some other basis, the results, all other things being equal, will prove of material benefit to the owner and will place the architect in the best possible position to obtain the most satisfactory results in all directions.

There may be said to be three ways in which work can be figured besides the usual way of obtaining competitive estimates from several parties. First, to have the work done by the day; second, to have the work figured by some one person without letting him know that it is being done without competition; and third, to call in the contractor,— who, all things considered, seems to be the best qualified to execute the work at hand,— and tell him frankly if he can give a satisfactory figure he can have the contract. Whatever advantages the first method may have, there is one serious objection to it for which there is no apparent remedy, and which consequently renders it impracticable except in rare instances; the fatal objection to day work lies in the fact that the journeymen employed on the job always learn in some unaccountable way of the manner in which the job has been let, and work with the idea that it is for their employer's interest as well as their own to make the work last as long as possible. Such inertia it is practically impossible to overcome; and this condition alone, and without various contributing causes, is sufficient reason why day work infallibly overruns the most liberal preliminary estimates. And this is a sufficient reason for not adopting this method except, as has been said, under peculiar or unusual conditions.

The second and third methods are practically the same, except in the first case the true facts are only partially known to the contractor, but it is doubtful if the results justify the mild deception which is practised when the architects pretend that the work is to be figured in competition; in fact, it is quite questionable whether the average builder can be kept in blissful ignorance of the true state of affairs, and if he learns or even surmises the true facts of the case he is much more liable to recognize and improve his chance for liberal profit than if the true conditions were presented for his consideration. It is an indisputable fact that the average man meets the opportunity which has been given him outright much more fairly, squarely, and liberally than he does the one which he has won in rivalry. The spoils of war, even in such mild encounters as the competition for building contracts, seem to carry certain rights, which are unfortunately and unjustly looked upon as inherent, which cannot be easily changed, and which work to the ultimate disadvantage of both the owner and the architect. It is sufficient, in support of this fact, to call attention to the practise of figuring work at cost and depending upon extras and other similar tricks of the trade to acquire a profit, and it can be seen that if a reputable contractor is given the opportunity to include his profit in the original proposition he is in honor bound to do additional work at fair prices.

As plans and specifications near completion, and the architect has mastered the details of the problem, he naturally considers to whom he would award the contract if left free to do so, and instinctively, as a rule, he makes up his mind that, all things considered, there is some one individual or firm who are better fitted to do this given piece of work than any other. Let the architect lay these facts clearly before the owner, and if he is clear sighted enough to realize his opportunity, he will allow the work to be given out without the usual competition, which so often handicaps all concerned at the very start. Another advantage, and by no means an unimportant one, in awarding work in this manner lies in the fact that it is much easier, when proceeding under this plan, to regulate and control the sub-contractors, the importance of which is readily recognized by any one who has had experience in building.

The great objection which is urged against this plan of awarding contracts without competition is the prevalent idea that no client would listen to such a proposition; in fact, we are often given to understand that it would weaken the position of the architect to suggest such a radical proposition. But if the proposed building has been worked out in such a way that sharp competition is not necessary to bring the figures within the limits, it is reasonable to suppose that an intelligent owner can be made to see what will result in a substantial benefit to himself. This method of procedure is at least worth a fair trial in all cases where it promises to bring about improved relations and a better standard of work. And every case which is successfully carried out creates a precedent which makes it easier to accomplish the desired ends in the future.

THE manner in which the huge gasometers on the site of the new South Union Station, Boston, were demolished was certainly novel and interesting. These were built of brick, with very heavy walls so strongly knit that the roof of one of the buildings was blown off with dynamite without weakening the walls in the least, although before the dynamite was used the iron bolts and braces had been removed. In taking down the brickwork an application was made on a gigantic scale of a principle often used in cutting butter and cheese. At intervals of about twenty-five feet about the gasometer were narrow windows extending the greater portion of the height of the wall. A strong wire cable was made fast to the ground at the base of the inside of the wall, carried over the top and down to the ground on the outside on the line of a window, and taken through a pulley block to the drum of a hoisting engine. When all was ready the engine was started, the wire wound up on the drum, and the great strain forced the cable to cut vertically through the bricks and mortar almost as smoothly as it might have passed through an immense cheese. After the brick wall had thus been cut vertically a table was passed around a pier between two windows, the hoisting cable attached to this cable on the inside and thence carried over the top of the wall and directly to the hoisting machine. When the power was gradually applied the immense slice of wall began to reel and totter and finally fall with a crash on the outside of the enclosure. This is about as expeditious a way of removing a large mass of masonry as we have ever heard of, and accomplished the desired result with great satisfaction.

A NUMBER of years ago, when the practise of building operations in Chicago was much cruder than it is at present, one of the basement piers in a large building in process of erection began to show signs of such manifest weakness that the authorities interfered, the superstructure was shored up, and the pier was taken down. Investigation showed that the outside course of brick all around was laid up in admirable manner, but the inside of the pier was a mere mass of bats and a slight sprinkling of mortar. This is an extreme case, but in a very much less scale it is very apt to be duplicated in many buildings. The average brick mason will care enough for appearance to build the outside all right, but there seems to be a tradition among masons that mortar can be slighted on the joints that are hidden, and that if the space is simply filled up with brick, that is sufficient. As a matter of fact, the reverse is just the case. The strength of a pier depends far more upon the mortar than it does upon the brick, and we will venture to assert that a pier of light hard brick laid up in Portland cement mortar will be far stronger than a pier built of the very best quality of hard burned brick which is laid up with indifferent mortar sparingly applied. The only way to build a pier properly is to have the courses run clear through. The practise of grouting was formerly much more prevalent than it is now. If judiciously employed, grouting strengthens a pier immensely; not that the grouting of itself is as good as mortar, but because the chances are the joints will be more thoroughly filled; but at the same time, if the bricks are thoroughly rubbed in at each course, and plenty of mortar used so each brick is surrounded by it, the resulting pier will be a great deal better than one in which less mortar and more grout is used. The secret of all good brickwork is to preserve a thorough bond, and to use plenty of the right kind of mortar.

METHODS OF BEDDING BRICK.

ONE of the papers read before a recent meeting of the Architectural Association of Great Britain dealt with the materials employed by bricklayers and the methods of using them. While the subject is treated from a purely English point of view, many points touched upon are of interest to American readers, and we present the following extracts: I have often found that the quality of the sand used for building purposes does not receive the attention it deserves. A clean, sharp sand is essential to the making of good mortar, whether mixed with lime or cement. The many impurities to be found in sand must act injuriously and tend to detract from the strength of the mortar. The best way to avoid this is to wash the sand, but the expense attached to this process prevents its general adoption. Where a mortar mill is used the "clinkers" from a dust destructor, mixed in reasonable quantities with sand and lime or cement, make a good mortar. But it is always an important point to see that a proper proportion of lime or cement is used, which is not always done.

I think it is essential (except during the winter months) that bricks should be well wetted before being laid. This is all the more necessary where cement mortar is used. The only possible way to secure strong work is to "grout" each course of brickwork, and this is where the advantage of washed or well-screened sharp sand is seen, as it will more readily fill the open joints of the brickwork. The plastering of mortar on the top of each course will not do. But the fact that wet bricks make bricklayers' fingers sore may have something to do with the neglect of wetting bricks. In work that is to be pointed after the building is erected the joints should be raked out one half inch deep and well brushed off with a hard broom, to clear away all loose mortar, and the pointing should be well pressed or "ironed" in the joints. In glazed or enameled work it may be often noticed that after a time the "glaze" flakes off and the defective part appears black. This is very often due to using chipped or defective bricks; but it is also due sometimes to another cause — viz., the mode of bedding them. The bricks having two deep "frogs" and generally being laid in a close joint, care is not always taken that sufficient mortar is spread to insure the frogs of the brick being solidly filled, so that when the weight comes on the wall the pressure is largely on the outer edge of the brick, and causes the "glaze" to fly. One way to obviate this is to fill the frogs before laying the bricks. Another way is to joggle either the end or side of the brick before bedding, and fill or "grout" them up with liquid mortar. The conditions of present day building often compel builders and others to carry on their works in sections. Very often walls are built with a vertical "toothing." If this cannot be avoided, I think the connection or making good to such toothing should be done with cement.—*Carpentry and Building.*

Recent Brick and Terra-Cotta Work in American Cities, and Manufacturers' Department.

NEW YORK.— The election is over, and Robert A. Van Wyck, the Tammany candidate, has been chosen first mayor of Greater New York. A great deal of speculation is being indulged in among architects and builders as to the personnel and conduct of the new Department of Buildings, which will have, after January 1, jurisdiction over a city containing 360 square miles; and as we are confidently looking forward to a busy year, the department will have enough to do, and will need at its head men of more than ordinary skill and resource.

RESIDENCE OF DURBIN HORNE, ESQ., PITTSBURG, PENN.
Peabody & Stearns, Architects.

The official figures of the department, showing the amount of building operations transacted during recent years, are as follows: In 1895 there were 3,206 plans filed, aggregating $72,932,220; and in 1896, 3,848 plans, aggregating $84,068,228. In the first nine months of 1897 there were 2,713 plans filed, aggregating $71,326,605, so that the present year promises to be the most prosperous of all.

Simultaneously two large hotels, one for the accommodation of the wealthy, the other for the reception of the impecunious tradesman and labor, were opened last week. The first, the Astoria, in Fifth Avenue, is the largest and most beautiful hotel in New York. The interior is planned and decorated on a very lavish scale, the magnificent mural paintings being especially attractive. The exterior is a pleasing combination of red brick and Lake Superior red sandstone in the Flemish style, and although it does not join well with the Waldorf next door, it is an impressive building.

The second hotel is known as Mills House, No. 1, and is located on Bleecker Street, in a poor neighborhood. This building was built by Mr. D. O. Mills, from plans drawn by Ernest Flagg. It is a dignified building in the modern French style, with white brick and white stone trimmings. It is a very comfortable, almost luxurious home for the poor man, who can secure a lodging for a night, with bath, etc., for twenty cents, and the owner figures that the enterprise will pay expenses.

A remarkable feat was accomplished recently in New York which no doubt will interest readers of THE BRICKBUILDER.

A five-story brick tenement house, weighing 1,700 tons, was moved a distance of 30 ft. without so much as disturbing a single brick in the entire building.

The undertaking was fraught with many difficulties, but was undertaken and accomplished by W. K. Clynes, a contractor. The actual work of moving the building occupied six hours. Three weeks were spent in getting things ready.

Plans for the new building to be erected by the New York Medical College and Hospital for Women, in 101st Street, east of Manhattan Avenue, have been prepared by Wm. B. Tuthill. They provide for an eight-story fire-proof building, with a front of brick, terra-cotta, and limestone, which it is estimated will cost $90,000.

Plans have just been completed by C. B. J. Snyder, architect of the Board of Education, for two new school buildings. One to be located on 108th and 109th Streets, near Amsterdam Avenue, will be five stories, fireproof, steel skeleton construction, exterior to be granite, limestone, gray brick, and terra-cotta. It will cost $300,000.

The other will be erected on 89th Street, between Amsterdam and Columbus Avenues. It will be of brick and stone, and will cost $233,000.

F. C. Zobel, architect, has prepared plans for an eight-story brick and stone store and loft building to be built on 19th Street, near Fifth Avenue, at a cost of $150,000.

Neville & Bagge, architects, have planned eight five-story brick and stone flats and stores to be built on Willis Avenue, near 140th Street; cost, $150,000.

James W. Cole, architect, has planned two five-story brick and stone flats and stores to be built on 92d Street, corner Columbus Avenue; cost, $65,000.

RESIDENCE OF DURBIN HORNE, ESQ., PITTSBURG, PENN.
Peabody & Stearns, Architects.

COMMERCIAL CABLE BUILDING, BROAD STREET, NEW YORK CITY. LOOKING FROM COURT OF THE MILLS BUILDING.
Harding & Gooch, Architects.
The white brick used in the façades of the building were manufactured by Sayre, Fisher & Co.

Wm. J. Fryer, architect, is preparing plans for an eight-story fire-proof office building to be built on Greenwich Street, corner Laight Street, taking the place of the building recently destroyed by fire. The cost will be $80,000.

CHICAGO. — The dulness existing in building is emphasized by the eagerness with which important firms seek unimportant work. Small contracts are followed up and courted by concerns who would have thought them not worth looking after three or four years ago. Although every one is anticipating better things just ahead of us, yet the records show for last month only a little improvement over the corresponding month last year when the presidential election was uppermost.

The annual exhibition of paintings at the Art Institute divided honors with the Horse Show lately, though it must be admitted the latter had decidedly the "swellest" crowd in attendance. The exhibition was considered a good one, and it was so overcrowded that a little more weeding might have been indulged. And yet, curiously enough, it is a conspicuous fact that a dozen of the best American artists were entirely unrepresented. Pittsburg held her exhibition at the same time, and her art endowment fund and better field of purchasers proved to offer superior attractions in the way of prizes and sales.

There is a rumor or two of an important building, but no specially interesting news. The government building foundation work, under the direction of General Sooysmith, is making rapid progress. The piling was driven first for the lofty central part, the steam drivers pounding and hissing busily night and day. Now the grillage and the concrete, and finally great pyramids of dimension stones are approaching the street levels, and the pile drivers have worked around toward the circumference of the surrounding groups of lesser foundations. The scene is an unusually interesting one for the student, and classes from the architectural department of the Art Institute make periodical visits under the guidance of an instructor.

The Chicago Architectural Club is promising to be active in its realm this year. It has a competition on now for an architects' club house. Mr. W. A. Otis recently gave a lantern talk on The Development of Architecture, and on another occasion the new president, E. G. Garden, exhibited working drawings of the Public Library Building, which were furnished through the courtesy of Messrs. Shepley, Rutan & Coolidge. The drawings were discussed, also, by Mr. F. M. Garden, who superintended the construction of the building.

BOSTON. — The remarkably open weather which has fallen to the lot of New England this fall has allowed almost uninterrupted work on buildings under process of construction. In consequence, these structures begun in early summer have pushed rapidly ahead, and are now, many of them, nearly roofed in and ready for interior finish. These later additions to the business blocks of the city are, as a rule, full of architectural dignity and grace. As they have approached completion, the old-time buildings in their immediate neighborhood have, by contrast, taken on a shabby aspect indeed.

THE REIBOLD BUILDING, DAYTON, OHIO.
Williams & Andrews, Architects.
The front of this building is of cream-colored terra-cotta. Executed by the Indianapolis Terra-Cotta Company, Brightwood, Ind.

The inevitable result of this will be the gradual rebuilding of the business district. Already many of the adjacent property owners are considering the erection of new structures.

While the building industry in every city suffers periodically to a greater or less extent from the wiles of the speculative builder, yet Boston has been this season particularly afflicted in this respect. To such an extent have material men been victimized by these worthless operators that most of them now refuse to do business with any speculative building whatsoever, unless cash is paid on delivery of material. In some of the other cities the material men have, by combining and refusing to sell other than absolutely responsible parties, succeeded in shutting off this most undesirable class of builders. It would be a wise move on the part of the material men here if they would affect a like combination.

CAPITAL TO PILASTERS, FLANKING ENTRANCE GEORGE GOULD RESIDENCE, LAKEWOOD, N. J.
Bruce Price, Architect.
Executed by the Perth Amboy Terra-Cotta Company.

In spite of the opposition and heated arguments which some of our good citizens have brought to bear against the erection of the new Westminster Apartment Hotel at Copley Square, because of the tendency of its towering height to dwarf the superb architectural proportions of Trinity Church and other adjacent structures, the enterprise has gone rapidly forward, and the foundations are about being laid. The estimated cost of the building is an even million dollars. It will be ten stories in height, of fire-proof construction. Up to the third story the material will be of buff Indiana Bedford stone and granite. The succeeding stories will be of Roman brick and highly sculptured terra-cotta. The roof will have a tile covering. Henry E. Cregier, of Chicago, is the architect; Woodbury & Leighton, of Boston, are the builders.

Among the new buildings now under process of construction or soon to be erected may be mentioned a new building for Jordan & Marsh, located on Avon, Bedford, and Chauncy Streets. This is to be an extension of their present retail store. Winslow & Wetherell, architects. To be constructed of brick and terra-cotta a new structure to be erected at the corner of Purchase and Federal Streets and Atlantic Avenue, on the property recently acquired by Wood, Pollard & Co. Plans for this building are being drawn by Shepley, Rutan & Coolidge, and it is rumored that the building is to be a fine hotel. The site of the property being directly opposite the New Terminal Station, gives some ground for this statment.

TERRA–COTTA PANEL, RESIDENCE, JERSEY CITY, N. J.
Executed in terra-cotta by the Conkling, Armstrong Terra-Cotta Company.

There will be an addition the first of the year to the Homeopathic Hospital, East Concord Street, Boston; H. K. Hilton, architect, Providence, R. I. To be constructed of brick and terra-cotta.

A nine-story business block will be built by the Boston Wharf Company; M. D. Safford, architect. To be constructed of brick and terra-cotta.

Six houses on the Bay State Road, Mr. Geo. W. Wheatland, owner; H. D. Hale, architect. To be constructed of brick and terra-cotta.

New schoolhouse for the city of Haverhill. Plans in competition among Haverhill architects. To be constructed of brick and terra-cotta.

A stable on Troy Street, R. H. White & Co., owner; Peabody & Stearns, architects. To be constructed of brick.

New schoolhouse for the Roxbury district; Andrews, Jaques & Rantoul, architects. To be constructed of brick and terra-cotta.

New schoolhouse for South Boston; H. D. Hale, architect. To be constructed of brick and terra-cotta.

New schoolhouse for East Boston; architect for which has not been appointed.

$100,000 hospital at Attleboro, Mass., Dr. J. M. Solomon, owner. Architect not given out.

$100,000 business block at Hartford, Conn.; Isaac Allen, architect. To be constructed of brick and stone.

New $75,000 dining hall for Harvard College, Cambridge, Mass.; Wheelwright & Haven, architects. To be constructed of brick and stone.

A new hospital at West Newton, Mass.; Rand & Taylor, Kendall & Stevens, architects. To be constructed of brick and stone.

Parochial residence at Woburn, Mass.; W. H. & J. A. Maginty, architects.

$75,000 apartment house at Brookline, Mass.; J. P. & G. H. Smith, architects. To be constructed of brick.

A mammoth apartment hotel on Commonwealth Avenue; Arthur Bowditch, architect; Webb Granite Construction Company, builders. This job was projected last year, but was laid over until the present time. It is now reported that work will shortly be begun on same.

A new apartment house, Springfield, Mass.; H. H. Gridley, architect. To be constructed of brick and stone.

New engine house, Salem, Mass.; Bickford & Graves, architects. To be constructed of brick and stone.

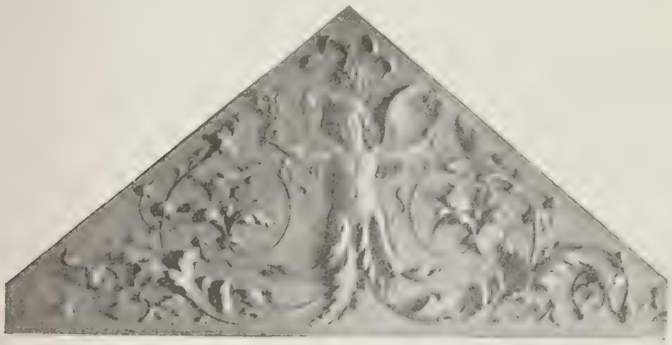
A $200,000 apartment house, Providence, R. I.; Martin & Hall, architects. To be constructed of brick and stone.

Two residences on Commonwealth Avenue; R. C. Sturgis, architect. To be constructed of brick.

A $100,000 combination store and apartment block at Lowell, Mass.; Merrill & Clark, architects. To be constructed of red brick and terra-cotta.

ST. LOUIS. — No small interest has been taken by some of the architects in the competition for the new City Hall that is about to be built by our neighbor across the river, East St. Louis, to replace the one destroyed by the cyclone in May of last year. Some seventeen sets of drawings were submitted, and those of Architect E. Jansen selected by the committee as, in their opinion, being the

best suited to the needs of their city. Architects May and Wees, of this city, and Meuller, of East St. Louis, were each awarded prizes. The terms of the competition were much more satisfactory than is usual in such cases, and were such as might be used in competition in the Ecole des Beaux Arts. The design selected is French Renaissance, and provides for the city offices on the first floor and basement, the city court and council chambers, with committee rooms, judge, and jury rooms, etc., on the second, while the third floor is to be used for a large hall. The cost will be about $80,000.



TERRA-COTTA DETAIL.
Executed by the Northwestern Terra-Cotta Company.

Owing to the fact that the enterprising little city has been trying to raise herself out of the mud by raising the streets 8 to 12 ft. above the grade, she found herself without the means to rebuild after the storm, the limit of taxation permitted by law having been reached. To relieve their city of its embarrassment, public-spirited citizens came forward and furnished the money, the city to repay them in an annual rental.

An interesting old landmark, the Wabash Building, which was used for so many years by the Board of Education and Public Library, was destroyed by fire the latter part of last month.

A bill has been introduced into the House of Delegates to give a ninety-nine year lease of the site of our present court house to a syndicate, which proposes to erect thereon a ten-story building, covering the entire block, the building to be arranged for the courts and public offices on the upper floors, and the other floors for offices suitable for lawyers, etc. The scheme has been up for consideration before, but has assumed more tangible form, and has brought forth considerable comment.

There has been no material change in the outlook during the last month, the amount for building, according to the report of the building commissioner, being even less than for the same month last year.

MEMPHIS.— THE BRICKBUILDER has published from time to time the outlook for building East, West, and North, but has little to say of the vast amount of work continually going on in the South, where the use of brick and terra-cotta in the construction of buildings large and small justifies at least an occasional item of recognition in its columns.

The new City Hospital Buildings now under way, which will cost when completed $200,000, were designed by Architect Samuel Patton, deceased, of Chattanooga. Mr. Patton lost his life in a Chattanooga, Tenn., fire, and thereby hangs an interesting story. Mr. Patton's rooms were in the Richardson Building, and he could easily have saved himself but for the fact that he made an effort to get his drawings for the proposed new Capitol Building of Mississippi, before leaving the burning building. The Governor of Mississippi had vetoed the bill authorizing the adoption of Architect J. Riley Gordon's plans for the capitol, which had been selected from ten or fifteen competitive sets, Mr. Patton's bei ng among the number. Mr. Patton had gone to much trouble and expense in making a second set of drawings, and his anxiety to save these drawings cost him his life. It might be mentioned here that the State of Mississippi contemplates the erection of a $1,000,000 capitol, which will doubtlessly be thrown open again to competition, as the legislature and Governor could not agree at the last meeting.

The new Memphis Market House and Cold Storage Building, also under way, involves the expenditure of about $75,000 and will be completed in the early spring. The plans were furnished by Alsup & Johnson, architects, of Memphis, who were paid 2½ per cent. for their drawings, and the contract for superintendence given to another firm of architects, Weathers & Weathers, of this city. A councilman attempted a bribe when the contract for plans was first awarded, was sentenced to a heavy fine, and ousted from the city council. The employment of one firm for plans and another for superintendence is certainly an innovation in this part of the country, and shows a few of the peculiar methods of public "jobbing" practised North as well as South.

Few cities can boast of as rapid progress in the building of costly city residences as Memphis. Within the last year at least a dozen homes have been built that would grace the principal thoroughfares of any of the larger cities. A "costly" residence with us means the expenditure of from $50,000 to $75,000 exclusive of lot and furnishings. The majority of these houses are built of brick and stone, and in only one instance has the colonial style been closely followed. Architects Dodd & Cobb, of Louisville, Ky., elaborated their design for the Kentucky Building at the World's Fair, and from these plans has been erected one of the finest and costliest examples of colonial work in the South. I mention the use of colonial work because no other style is so peculiarly adapted to our climate, and with so many beautiful examples all around us it is a wonder that the style should be almost entirely abandoned by Southern architects. What might be termed the "castellated style" has been the theme for most of the "costly" houses, and miniature turreted castles have grown up all about us. The only serious objection to this so-called style is the peculiar appearance that the enormous verandas and uncovered "porches" give to the house.

The much-debated question of licensing architects brings to mind the fact that architects in Memphis, until last year, were required to pay a city and county tax amounting to nearly $100. We are by no means exempt from the combined "contractors and architects," however, and their methods are much the same here as elsewhere; but when it comes to unique methods of advertising, we hold the record. A draftsman for one of the firms of contractors here has branched out for himself with this startling sign,— "Expert, Practical Architect and Scientific Housemover,"— displayed on the private residence of the "architect." His own house is only half completed, but in its half-finished state is proudly shown by the possessor as an instance of what can be done toward building a $5,000 house with $1,000. This "scientific housemover" also has his startling "ad" painted in conspicuous letters on his buggy — but, to be more exact, his vehicle.

TERRA-COTTA DETAILS, APARTMENT HOUSE, CHESTNUT STREET, PHILADELPHIA.
Walter Smedley, Architect.
Executed by the Conkling, Armstrong Terra-Cotta Company.

RESIDENCE OF A. B. GARDINER, DOWAGIAC, MICH.
W. K. Johnston, Architect, Chicago.
Roofed with 8 in. Conosera Tile, made by Celadon Terra-Cotta Company.

Not only has Memphis made rapid strides in the way of office buildings and handsome residences, but also Atlanta, Nashville, Louisville, and Chattanooga. In fact, the South offers a field of labor for the architect that allows him scope for nearly every style and class of building, and we are welcoming the extensive and substantial use of materials in clay which until recently played a very small part in the upbuilding of our cities.

THE accompanying cuts show two elevations of residence, and one of stable, designed by Architect W. K. Johnston, Chicago, for Mr. A. B. Gardiner, at Dowagiac, Mich., which are roofed with 8 in. Conosera tile and graduated tower tile, manufactured by Charles T. Harris, lessee of the Celadon Terra-Cotta Co., at Alfred, N. Y.

The walls are of field boulders laid up rough as shown, and the effect in connection with this style of tile roof is very artistic.

But the picture can give no impression of the fine color scheme secured; these broken boulders are of a great variety of color tones, and the roof is a warm red, thus securing a sky line in perfect accord with the building material and its surroundings.

STABLE A. B. GARDINER, DOWAGIAC, MICH.

RESIDENCE OF A. B. GARDINER, DOWAGIAC, MICH.
W. K. Johnston, Architect, Chicago.
Roofed with 8 in. Conosera Tile, made by Celadon Terra-Cotta Company.

INTERESTING NEWS ITEMS.

THE DAGUS CLAY MANUFACTURING COMPANY, Daguscahonda, Penn., will furnish the buff brick for the new Warren High School, Warren, Penn.

THE CUMMINGS CEMENT COMPANY, of Akron, N. Y., is furnishing large quantities of Rock and Portland cements for work on the Erie Canal improvements.

THE POWHATAN CLAY MANUFACTURING COMPANY are supplying their gray bricks for the New Smithdeal Business College Building, Richmond, Va.

THE PANCOAST VENTILATOR COMPANY are putting upon the market a handsome new square ventilator for buildings. Also a window ventilator known as the "Common Sense."

W. S. RAVENSCROFT & Co., brick manufacturers, Daguscahonda, Penn., have changed the company name to the Dagus Clay Manufacturing Company.

CHARLES E. WILLARD has secured the contract to supply the mottled brick on the Vega Society Building, New Britain, Conn.; W. H. Cadwell, architect, New Britain.

THE STANDARD TERRA-COTTA COMPANY, Perth Amboy, N. J., have increased their pressing department by adding a new building 110 by 50 ft.

SAYRE & FISHER COMPANY have the contract to furnish a large quantity of

white enamel brick for new residence of George Gould, Lakewood, N. J.; Bruce Price, architect.

THE Bolles Sliding and Revolving Sash have been ordered for the Citizens' Bank Building, Norfolk, Va.; Charles E. Cassell, architect, Baltimore, Md. This is a handsome seven-story office building.

THE PANCOAST VENTILATOR COMPANY furnished the large copper ventilators for the Astoria Hotel, New York City; also the ventilators for the Manhattan Beach Theater, at Staten Island.

SAYRE & FISHER COMPANY are supplying 300,000 gray bricks and 1,500,000 hollow bricks for the new thirty-story Park Row Building, New York City, of which R. H. Robertson is the architect.

THE UNION AKRON CEMENT COMPANY, Buffalo, are furnishing the Owego Bridge Company with the Star Brand Akron Cement for abutments to bridges at Mt. Morris, N. Y., and at Rockland, N. Y., also for foundation for asphalt pavement at Warren, Ohio.

FALL trade in fancy brick is reported exceedingly good by Messrs. Fiske, Homes & Co. Sales are largely in excess of last year, and future outlook for business in their high-grade specialties is quoted as very good.

G. R. TWICHELL & Co., Boston, are to supply face brick on the following work: Addition to the Chestnut Hill Pumping Station, Boston; building for fire department headquarters, Worcester, Mass. and Somerset Trust Building, Boston.

H. F. MAYLAND & Co., New York, representatives of the Burlington Architectural Terra-cotta Company, have secured the contract for furnishing the terra-cotta for a new store building in Brooklyn, of which C. F. Guyler is the architect.

RECENT inquiry at Cornell University elicited the information that the Cabot's Brick Preservative used upon several of the most prominent buildings several years ago had proved most satisfactory, thoroughly waterproofing the bricks and retaining its efficacy.

THE EXCELSIOR TERRA-COTTA COMPANY have secured through their New England representative, Charles Bacon, the contract to supply the terra-cotta for six houses on the Bay State Road. George Wheatland, owner; H. D. Hale, architect; W. D. Vinal, builder.

MR. GEORGE B. F. MAXWELL has assumed the sole agency, for Philadelphia, of the products of the American Mason Safety Tread Company, of Boston. Mr. Maxwell is widely known as having been for the past ten years designer and salesman of church and lodge furniture for the firm of S. C. Small & Co., of Boston.

CONKLING, ARMSTRONG TERRA-COTTA COMPANY have secured through their New England agent, Charles E. Willard, the contract to supply the terra-cotta on the Dedham High School building, Dedham, Mass.; Greenleaf & Cobb, architects, Boston. Also the Sage-Allen Office Building, Hartford, Conn.; Isaac Allen, architect, Hartford.

THE RARITAN HOLLOW AND POROUS BRICK COMPANY, New York, are furnishing "Raritan" 12 in. mottled brick in a run of color for a large church in 88th Street, New York City. The molded work in this job is very elaborate, especially the Gothic arches for the cloisters. It is a fine example of the use of brick in church architecture.

THE FAWCETT VENTILATED FIRE-PROOF CONSTRUCTION COMPANY have been awarded the following contracts: Structural steel and fire-proofing for the new Masonic Temple, Boston; structural steel and fire-proofing for the Westminster apartment house, Boston; structural steel and fire-proofing for Mr. Winslow's (Winslow & Wetherell) residence, Boston.

SAYRE & FISHER COMPANY have secured through their New England representative, Charles Bacon, the contract to supply the brick for six houses on the Bay State Road. George Wheatland, owner; H. D. Hale, architect; W. D. Vinal, builder. Also the white enameled brick to be used in the Dean Building on India Street. Hartwell, Richardson & Driver, architects; George A. Fuller & Co., contractors.

THE AMERICAN MASON SAFETY TREAD COMPANY is placing strips of its safety material in a granolithic sidewalk on a steep incline on Bowdoin Street, adjoining the State House grounds, Boston, rendering the sidewalk perfectly non-slipping even in the most frosty weather. This use of the safety tread seems likely to become very largely adopted, as it enables the use of granolithic in places where it has been heretofore impracticable.

THE BURLINGTON ARCHITECTURAL TERRA-COTTA COMPANY, Burlington, N. J., have supplied terra-cotta on the following contracts: New building, Penn Institution for the Blind, Overbrook, Penn.; Cope & Stewardson, architects; residence at Overbrook, Penn.; Kean & Mead, architects; business front, Chestnut Street, Philadelphia; H. E. Fowler, architect; Hospital for Deaf Mutes, Trenton, N. J.; Thomas Stephen, architect; apartment house, Girard Avenue, Philadelphia; S. A. Stoneback, builder.

MEEKER, CARTER, BOORAEM & Co., New York, have closed contracts for 150,000 standard buffs, Hotel, 33d Street, near Broadway; H. J. Hardenbergh, architect; C. T. Wills, contractor; 125,000 standard gray bricks, apartment houses, 138th, 139th Streets, and Brook Avenue; Schickel & Ditmars, architects; A. A. Smith, contractor, and are now delivering white semi-glazed bricks and gray bricks to office building, 9–11 Maiden Lane; C. A. Cowen, contractor; R. S. Townsend, architect, all of New York City.

THE HAMBLIN & RUSSELL MANUFACTURING COMPANY, of Worcester, Mass., have appointed Fiske, Homes & Co., of 164 Devonshire Street, Boston, Mass., as their general agents on Standard Wall Ties, Slate Fasteners, and Wind Guards. Illustrated catalogues setting forth the Standard clinch system and the new method of slate roofing will be forwarded upon application. This system seems to be quite a step in advance of the old methods, and without doubt it will meet with ready approval, and a thorough investigation is invited to all interested in this line.

THE POWHATAN CLAY MANUFACTURING COMPANY, Richmond, Va. (New York office, Townsend Building), have sent us five sample brick, which are certainly worthy of the highest recommendation as being particularly fine specimens of their latest successes in gray and white brick. The general high reputation which the company's output has acquired among the building profession leaves little more to say of these samples than that they are, if possible, of a finer quality and more perfect shade than any which the company has before placed upon the market.

FISKE, HOMES & Co. report a good demand for their special ties, and have booked a large number of orders for fancy brick during the past few weeks. Among the more important are, the Westminster Chambers, Boston; High School, Needham; Fire Station, Dorchester; Richmond Court, Brookline; Pumping Station, Waterworks, Somersworth, N. H.; Warehouses on India Street,

city proper, and on A Street, South Boston; Y. M. C. A. Building, Fall River. Smaller orders include mercantile buildings at Salem, Beverly, Springfield, New Haven, Hartford, etc., with numerous apartment houses and private dwellings in and about Boston and throughout New England.

William Connors, of Troy, N. Y., has purchased for $40,000 the Olympic Mill property, 669, 671, 673, and 675 River Street. This is one of the best manufacturing sites in Troy, and has been owned by Orrs & Co. since 1835. It has two large water wheels of 150 horse power each. Mr. Connors proposes to remodel the present building and equip it especially for the manufacture of American Seal Paint, and erect a separate building, which will be used exclusively for the grinding of dry colors. The machinery to be used in operating this plant will be entirely new, of which Mr. Connors is the sole owner and patentee. His method not only reduces the cost of production, but makes a much better article than can be produced by the present means.

The Hydraulic-Press Brick Companies, through their New York and New England agents, Messrs. Fredenburg & Lounsbury, report the following contracts, pertaining to New England work only, that have recently been secured by them: Hotel, corner Beacon Street and Brookline Avenue, Boston, Mass.; Winslow & Wetherell, architects; Memorial Library, Adams, Mass.; William M. Butterfield, architect; Wellesley Chapel, Wellesley, Mass.; Heins & LaFarge, architects; apartment house, corner Beacon & Carlton Streets, Brookline, Mass.; Winslow & Wetherell, architects; Police Station, Hartford, Conn.; J. J. Dwyer, architect; New Bedford Pumping Station, New Bedford, Mass.; Rice & Evans, engineers; business block, Main Street, Hartford, Conn.; Isaac Allen, Jr., architect; engine house, West Roxbury, Mass.; John A. Fox, architect.

The Celadon Terra-Cotta Company, Limited, Charles T. Harris, Lessee, has recently closed contracts for roofing tiles on the following: Seven houses for E. L. Schiller, 81st Street and West End Avenue, New York City; Clarence True, architect; style, 8 in. Conosera; Meter house and Office for Gas Company, Omaha, Neb.; Wilson Brothers & Co., Philadelphia, architects; style, open shingle; water tower at State Hospital, Massilon, Ohio; Yost & Packard, architects; style, graduated Conosera; residence for Isaac D. Fletcher, 813 Fifth Avenue, New York; C. H. P. Gilbert, architect; style, open shingle; two towers for H. C. Rutt, Passaic, N. J.; style, 8 in. Conosera; Y. M. C. A. Building, Mansfield, Ohio; C. H. Martin & Brother, architect; style, 8 in. Conosera; United States Post-Office Building and Court House, Paterson, N. J.; supervising architect; style, Gothic.

We are in receipt of a very attractive catalogue of some fifty pages from the Eastern Machinery Company, New Haven, Conn., of their Improved Friction Clutches. We would recommend a perusal of this to those of our readers engaged in manufacturing, as being a very interesting little volume, full of information on this subject.

In it the principle on which their Improved Friction Clutches are constructed is described in a clear and concise manner, further explained by sectional cuts, etc. Besides pulleys for regular work, the company make a number of special pulleys, which are also described and illustrated.

The reputation for high-class machinery which this company has won for itself in connection with their line of clay machinery is certainly a guarantee as to the merits of their Friction Clutch Pulleys, and we are glad to recommend parties in need of same to correspond with them. Address, The Eastern Machinery Company, New Haven, Conn.

The Grueby Faience Company have secured the contract to supply the enameled brick to be used on the new Subway station at Haymarket Square. This company have recently equipped their factory with new represses, and are making some new and very attractive designs for tile work. They have recently finished a particularly fine piece of work in special Moorish tile of a dull-finished Alhambra pattern for a bath room in the Moores' residence, in Detroit; A. W. Chittenden, architect. They have also supplied the faience work for an addition to the house of H. C. Warren, of an open loggia roof, supported by brick piers, between which are panels of blue Chinese tile, forming a balustrade. Capitals of these piers are made of gray, dull-finished fawn, to harmonize with the brickwork, the surface between the eaves being blue to match the tiles below. The frieze above is enlivened in color by different shades of tile, set between the consoles. The effectiveness of this combination is most artistic and attractive, and shows the possibilities that may be achieved in this direction by the use of faience in exterior decoration.

Attention is called to what would seem to be a rare opportunity to acquire a most desirable modern brick plant in the heart of the clay-manufacturing district of Ohio. The owner of the plant is obliged to remove to Colorado on account of health, and is willing to dispose of the property at a "great bargain."

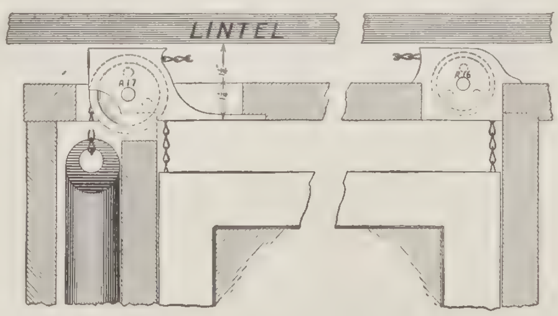
The product of this plant is well and favorably known in the market, and it has facilities for manufacturing and shipping that are particularly favorable. The location is on a belt line of railroad that connects with seven different systems, including the Baltimore & Ohio, and the Pennsylvania. We are informed that there are extensive beds of red and buff clays right at the works, and that the best coal can be obtained delivered at the kilns for $1.00 per ton.

The plant is equipped with six down-draft kilns (holding 800,000 brick) with exhaust fan system attachment, and has a daily capacity of presses of 30,000 brick. There is in stock a very large line of molded dies, claimed to be the most extensive in the State.

Any parties interested in acquiring a property of this kind should not fail to investigate this plant. For further particulars see advertisement on another page.

While the building profession have for a long time recognized the mechanical advantage and economical saving in space of the overhead window pulley in comparison to the old style side pulley, yet in the past it was impossible to use them without making special provisions. This difficulty has been overcome by an ingenious device known as the "Queen" Overhead Pulley, a patent on which was granted last September to U. G. McQueen, Manager of the Queen Sash Balance Company, 150 Nassau Street, New York, N. Y.

The various objections to the old style of overhead pulley have been fully overcome in the "Queen," as may be seen by the accom-



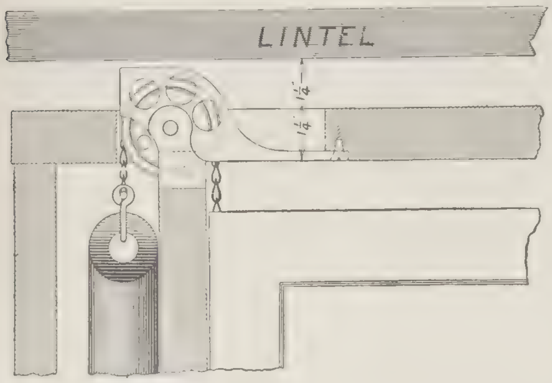
THE "QUEEN" MULLION FRAME PULLEY (ONE WEIGHT BALANCES THE SASH). THIS CUT SHOWS A 2½ IN. PULLEY.

panying illustrations. Some of the advantages claimed by the company for the Queen pulley are as follows: it can be placed in any window in which the ordinary side pulley can be used, at a gain of a large amount of pocket room, thus doing away with lead weights and reducing cost; no grooving of the sash is necessary, and no extra space for head room need be allowed. No iron or steel work

in any building will in any way interfere with its perfect action, and it requires, at least, one inch less head room than any other overhead pulley.

All sizes, styles, and kinds of finish are given in the company's catalogue, and many of the best buildings now being constructed in New York are equipped with these pulleys. It has the endorsement of the leading architects.

The Mullion Frame Pulley, here shown, is designed to do away

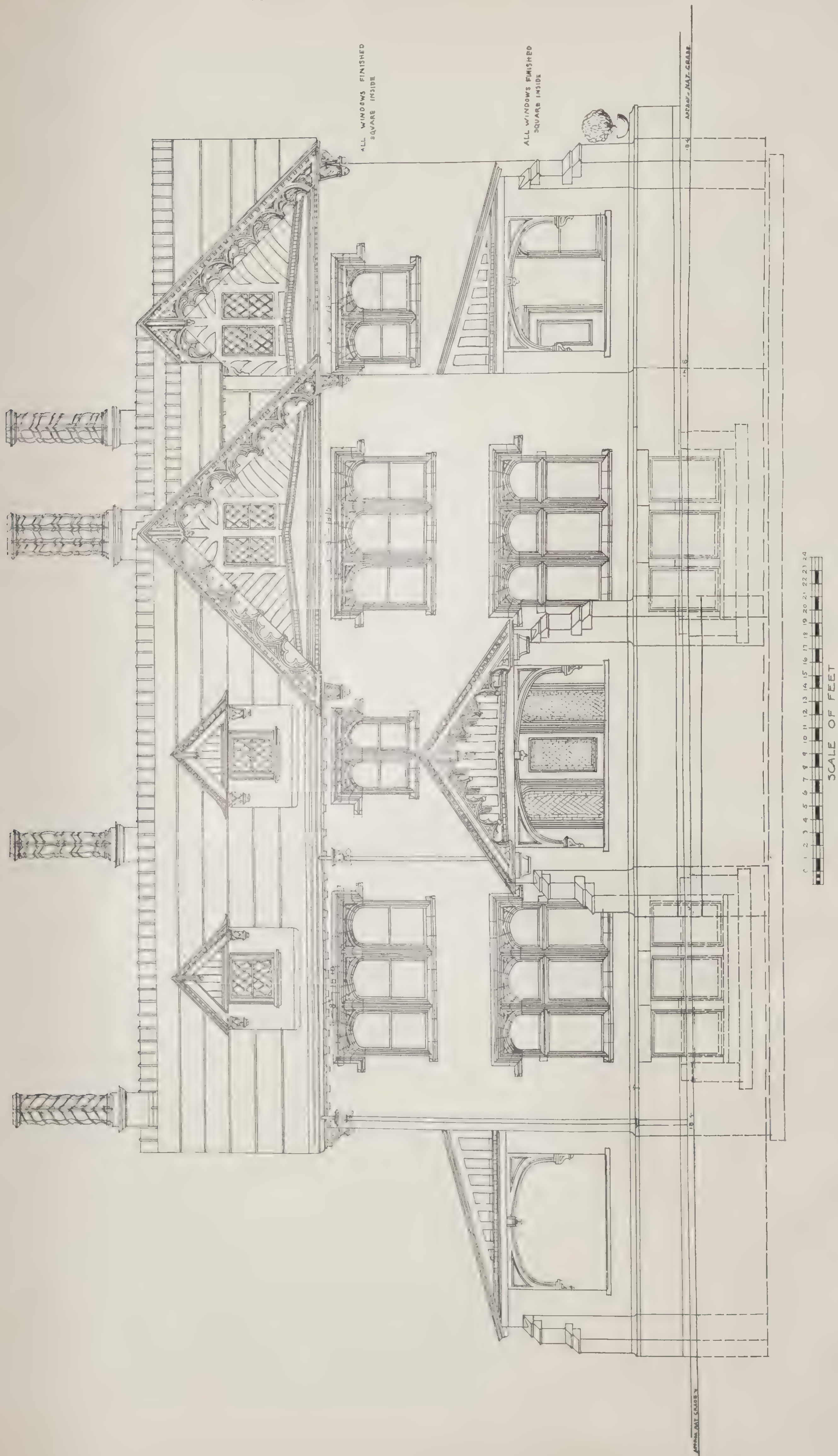


THE "QUEEN" SINGLE FRAME PULLEY. THIS CUT SHOWS A 2½ IN. PULLEY.

with the mullion pockets in twin windows. When these pulleys are used, the sashes are operated by one weight with the same result as by using two weights, and from six to eight inches more glass space is given than by ordinary methods.

"The difficulty heretofore experienced in threading overhead pulleys has been overcome by the 'Queen' pulley, and a new style of mouse for use in threading the pulley with cord, tape, or chain is furnished with each order."

The company will be glad to send a working model and catalogue to any architect, on application. All goods specified in the catalogue are kept in stock.

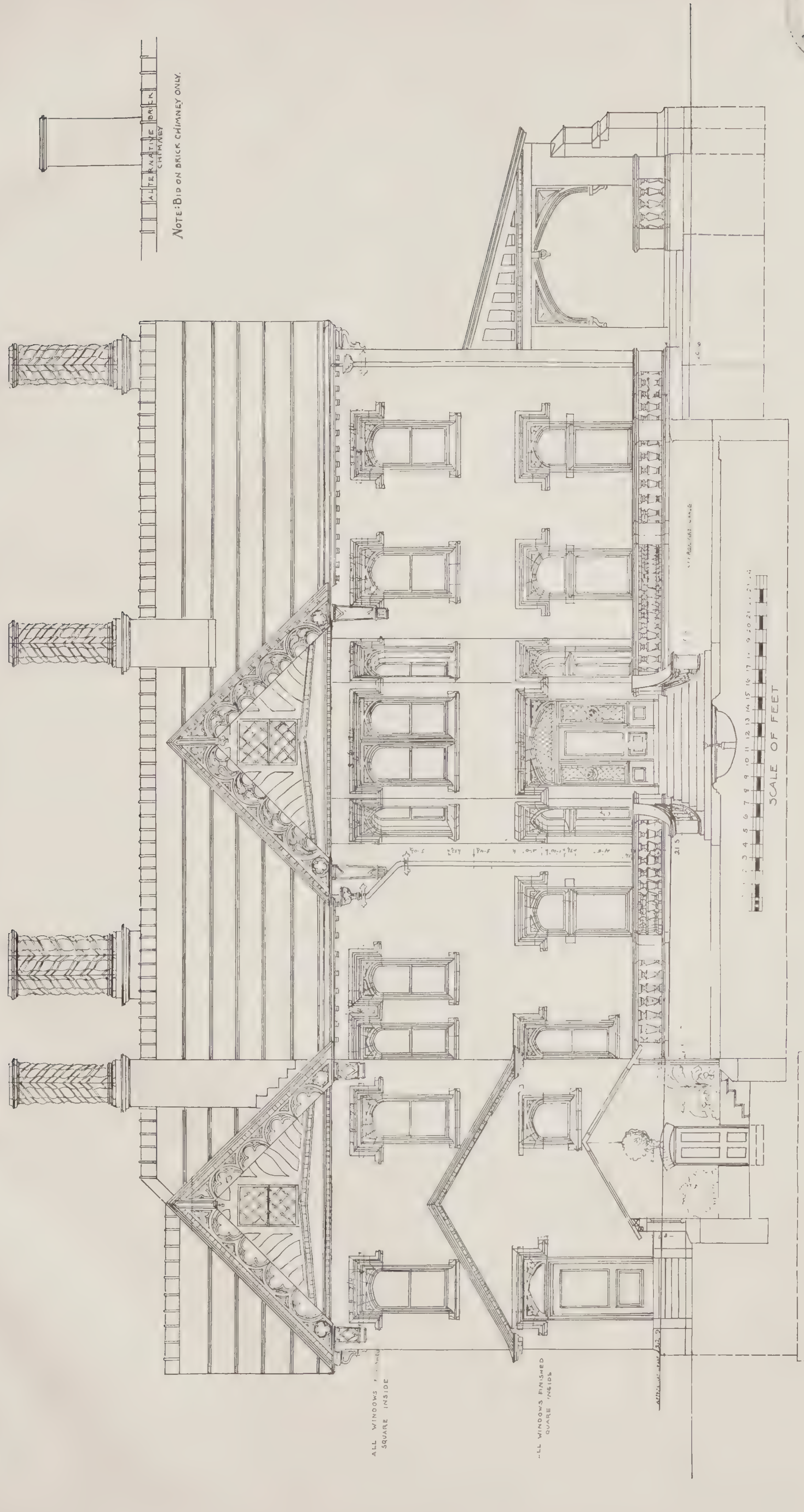


NORTHEAST ELEVATION.

RESIDENCE FOR DURBIN HORNE, ESQ., PITTSBURGH, PENN.

PEABODY & STEARNS, ARCHITECTS.

VOL. 6. NO. 11. PLATE 90.

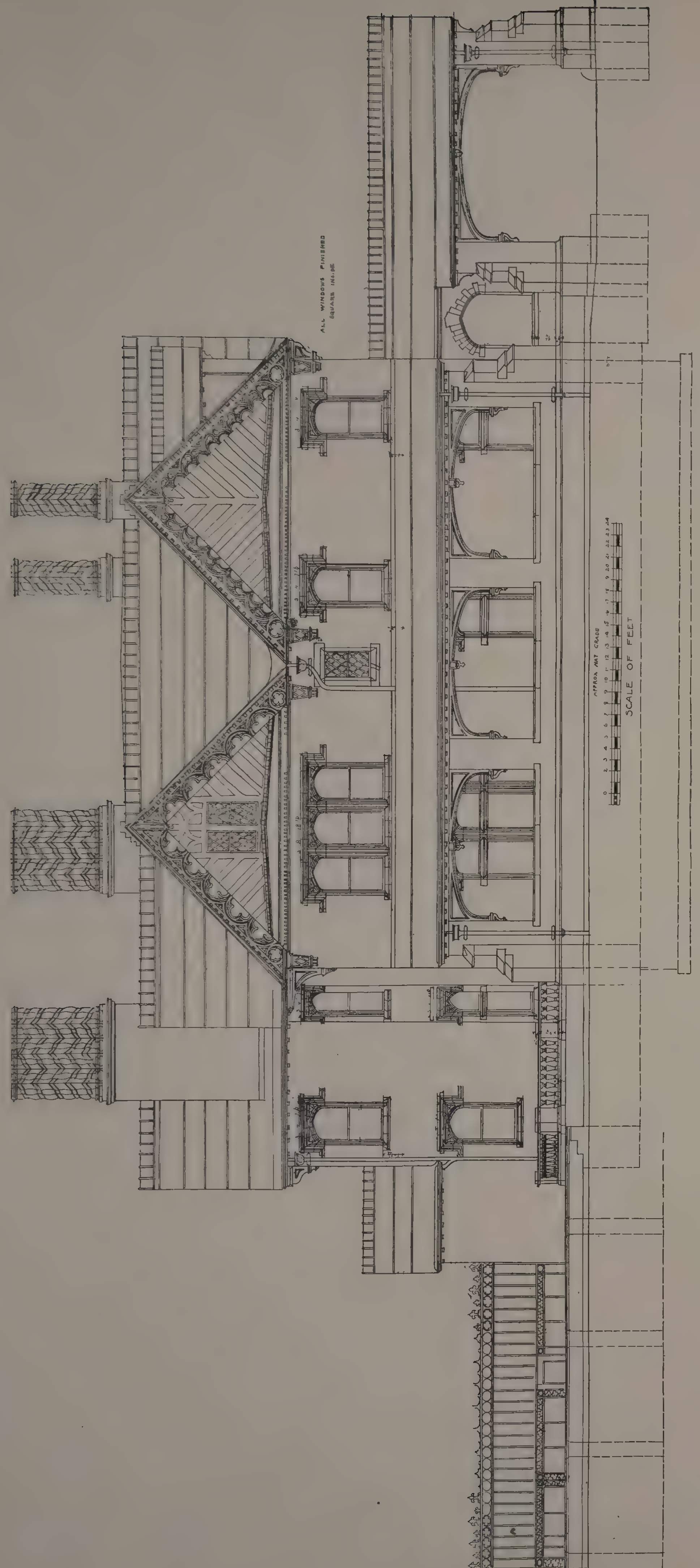


SOUTHWEST ELEVATION.

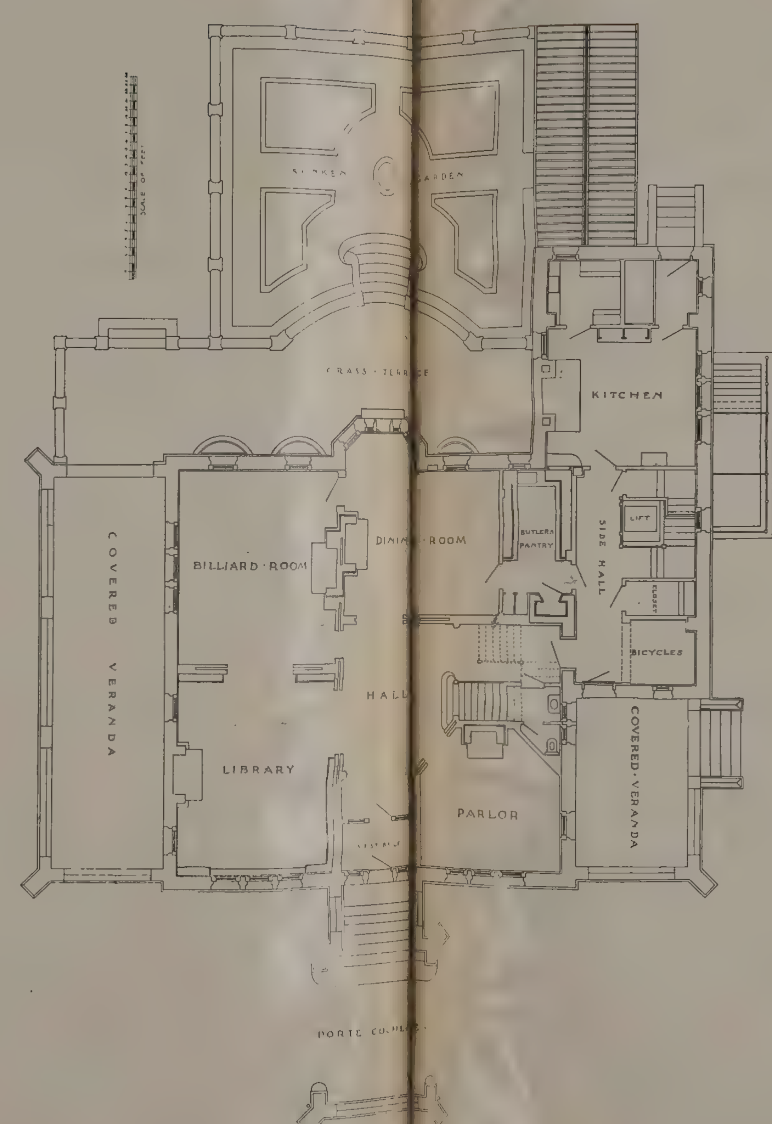
RESIDENCE FOR DURBIN HORNE, Esq., PITTSBURGH, PENN.

PEABODY & STEARNS, ARCHITECTS.

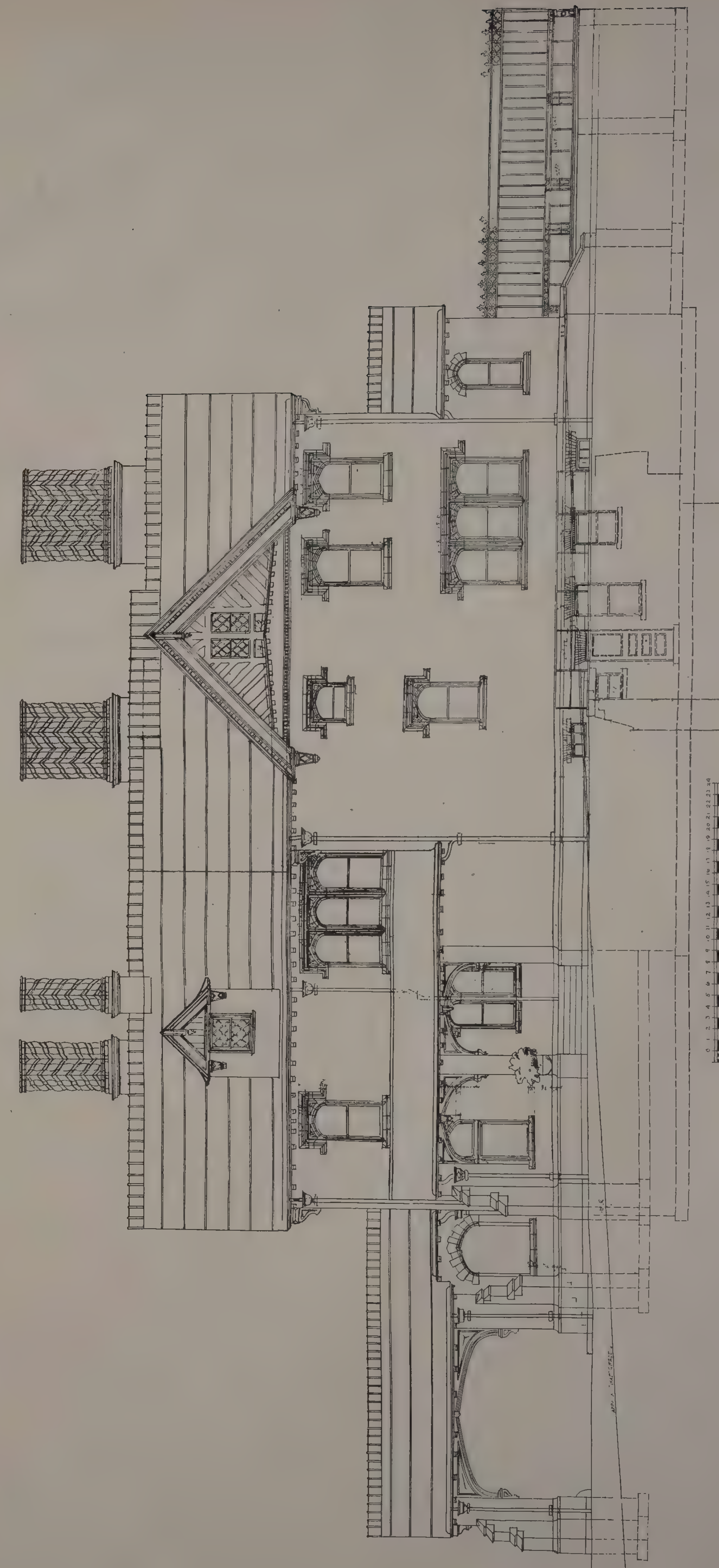
SOUTHEAST ELEVATION.
RESIDENCE FOR DURBIN HORNE, ESQ., PITTSBURGH, PENN.
PEABODY & STEARNS, ARCHITECTS.



Southeast Elevation.
RESIDENCE FOR DURBIN HORNE, Esq., PITTSBURGH, PENN.
PEABODY & STEARNS, Architects.



First Floor Plan.

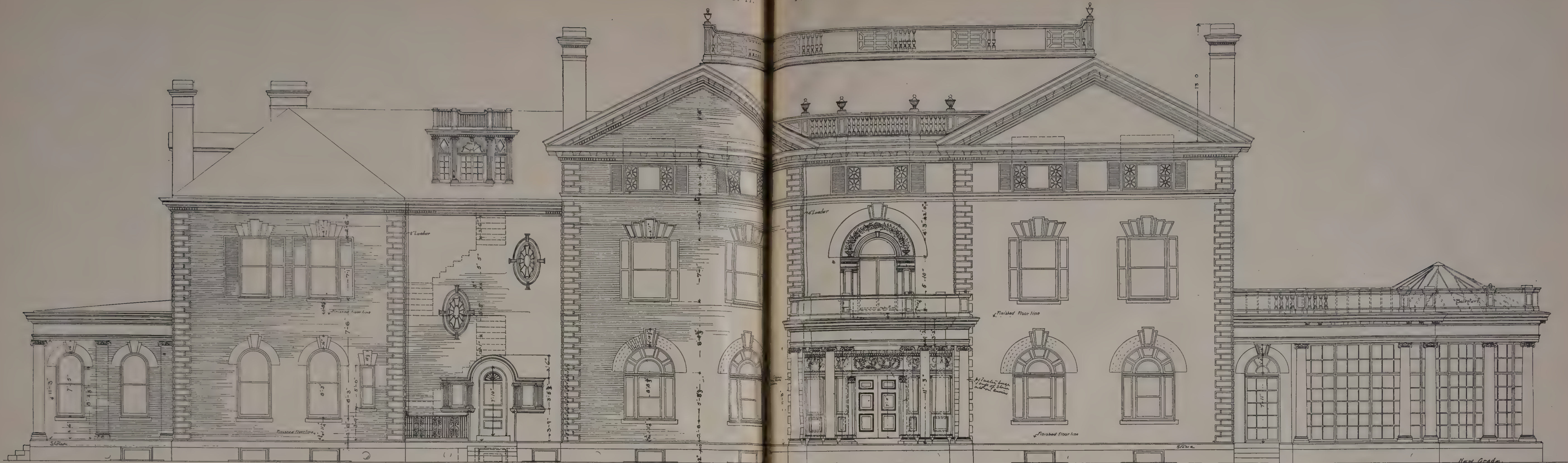


Northwest Elevation.
RESIDENCE FOR DURBIN HORNE, Esq., PITTSBURGH, PENN.
PEABODY & STEARNS, Architects.

No

RESIDENCE FOR FREDE
RENWICK, AS

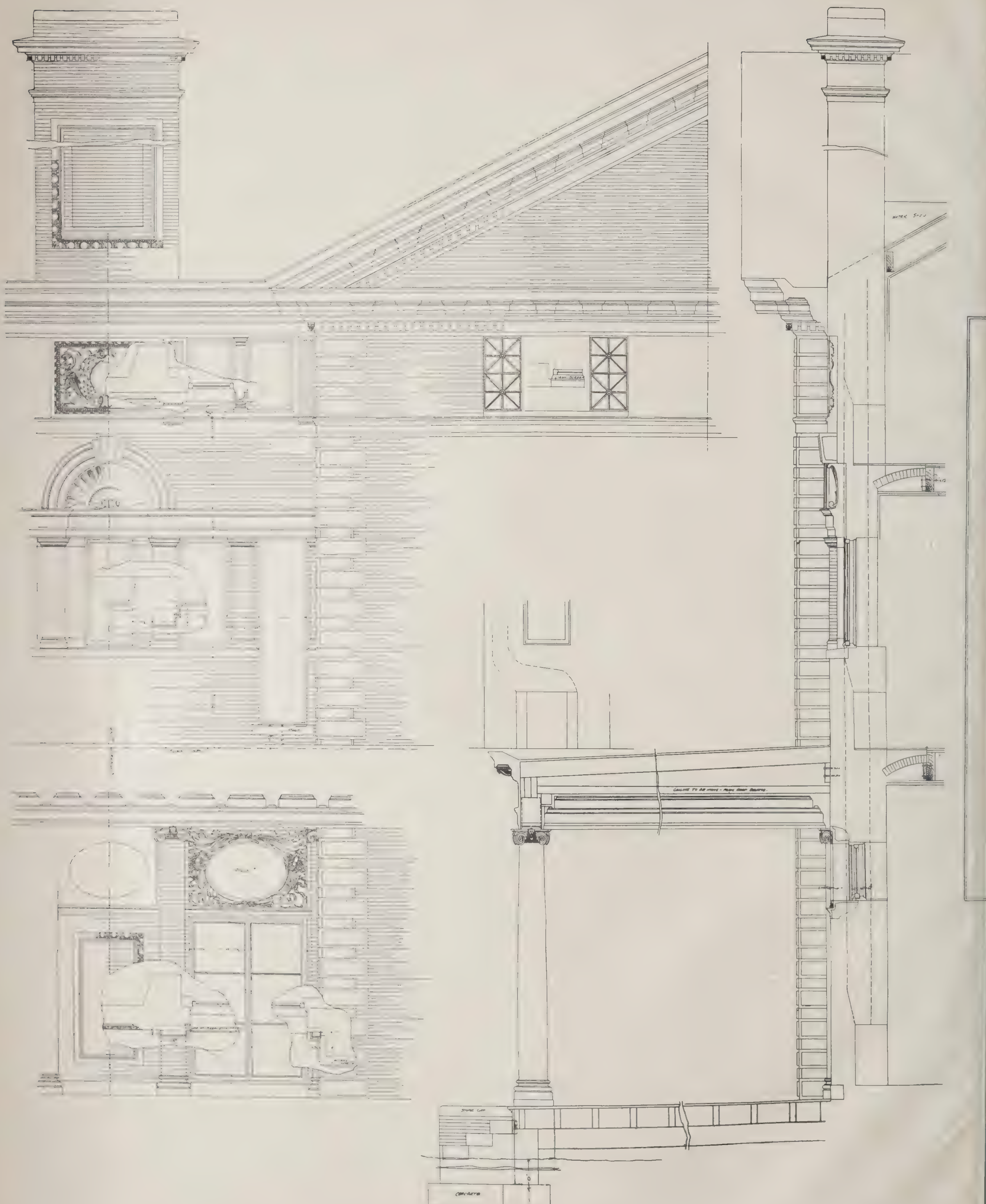
THE BRICKBUILDER.
VOL. 6. NO. 11. PLATES 93 and 94.



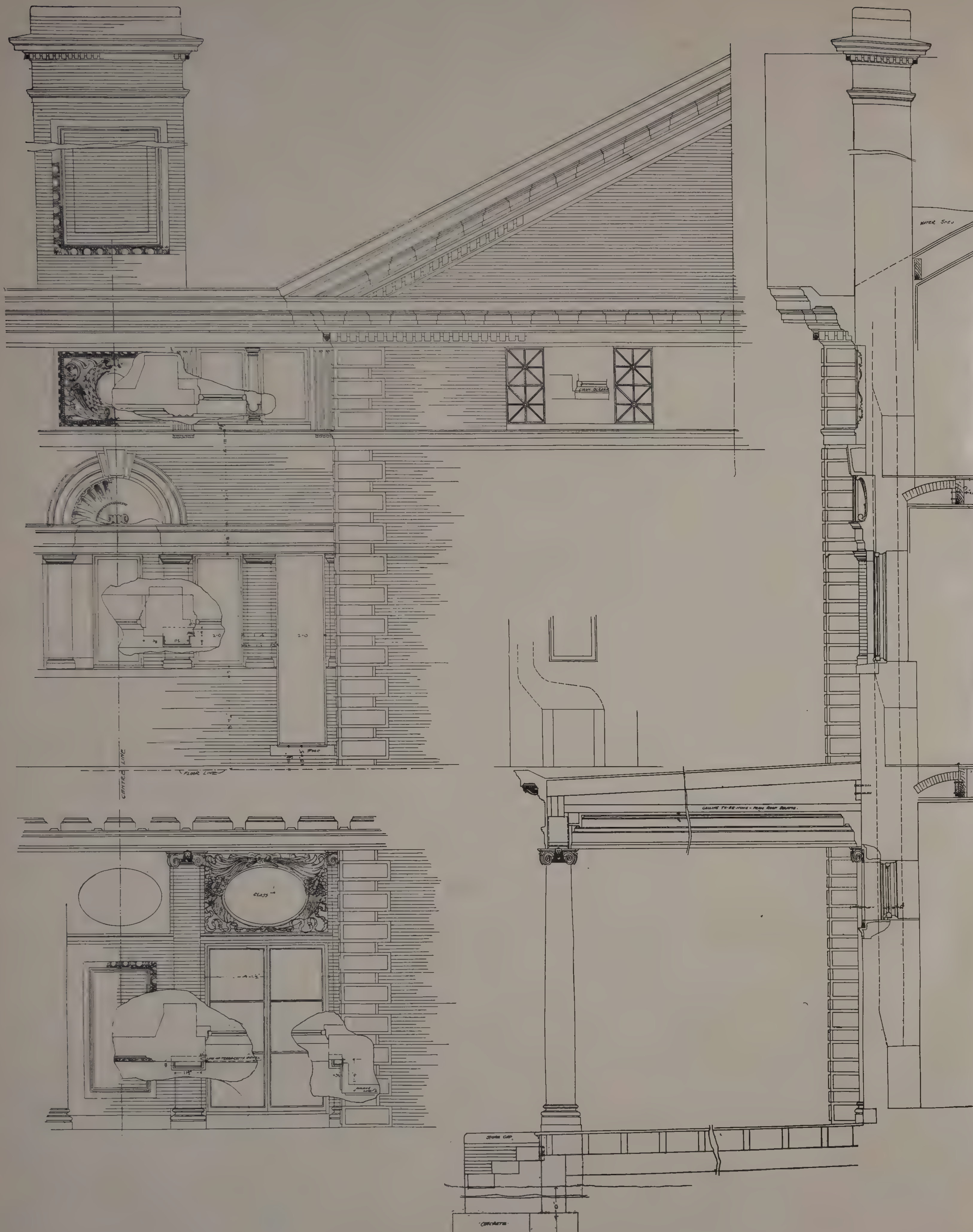
NORTH ELEVATION.

SOUTH ELEVATION.

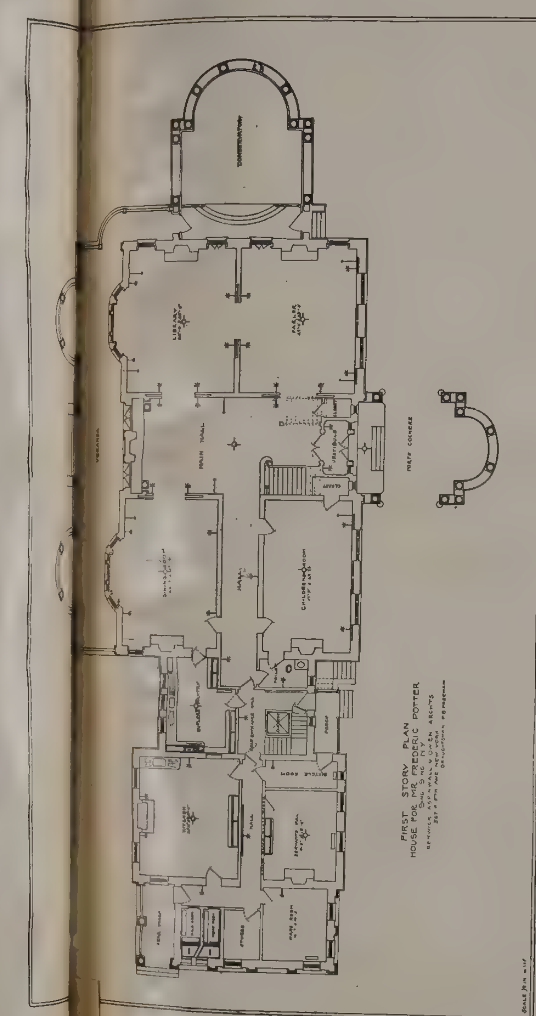
RESIDENCE FOR FREDERICK POTTER, Esq., SING SING, N. Y.
RENWICK, ASPINWALL & OWEN, Architects.

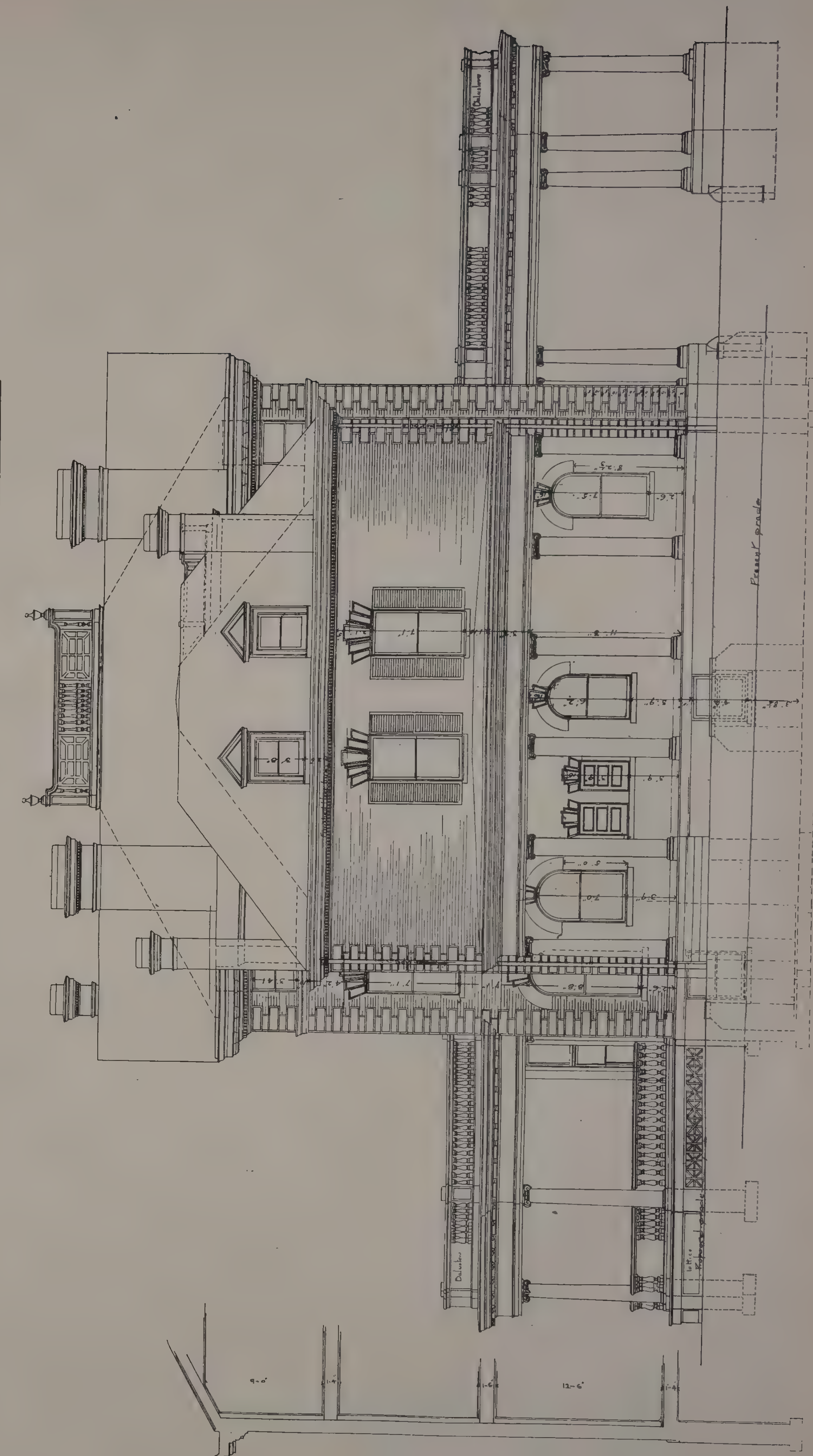


DETAIL OF CENTER RECESS, SOUTH ELEVATION.
RESIDENCE FOR FREDERICK POTTER, Esq., SING SING, N. Y.
RENWICK, ASPINWALL & OWEN, ARCHITECTS.



Detail of Center Recess, South Elevation.
RESIDENCE FOR FREDERICK POTTER, Esq., SING SING, N. Y.
RENWICK, ASPINWALL & OWEN, Architects.





East Elevation.
RESIDENCE FOR FREDERICK POTTER, Esq., SING SING, N. Y.
RENWICK, ASPINWALL & OWEN, Architects.

THE BRICKBVILDER
VOLVME VI DEC. 1897 No. 12
OFFICE 85 WATER STREET BOSTON

THE BRICKBUILDER.

AN ILLUSTRATED MONTHLY DEVOTED TO THE ADVANCEMENT OF ARCHITECTURE IN MATERIALS OF CLAY.

PUBLISHED BY

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HONOR TO WHOM HONOR IS DUE.

BETWEEN the financial necessity of making himself known, and the unwritten ethical code which forbids him to advertise his wares, the architect is not uncommonly squeezed out of a proper recognition of himself as a factor of his work. Now there is a right and a wrong use to make of an architect's name in connection with building operations. To parade the fact in print that so and so has done so and so, when his achievements are of little public interest or real merit, is certainly reprehensible. On the other hand, the architect has a perfect right to an acknowledgment of what he has done, and he is entitled to this recognition as publicly as the circumstances will warrant. When we read in the news columns a report of the dedication of some church or of some proposed public building, with a dozen or more names of committee men unknown to fame, we fail to see who, beyond a very narrow circle of personal friends, would be interested in such names; while the name of the architect, which is very apt to be lacking, is of deep business interest as well as of artistic importance to a great many. This is a principle which the public as represented by the utterances of the daily press is very apt to neglect, not with the idea of depriving the architect of what might be considered an advertisement, but because the desirability of coupling the man and his work does not appeal to the average news editor. When it is remembered that in a large building direct employment is given to many thousand craftsmen and artists, and that each one of these looks to the architect of ten for direct employment and always for possibilities of gain, it will readily be seen that the omission of the architect's name considered simply as a matter of news is a mistake, and that the thousands of manufacturers, mechanics, and contractors who have to do with the building have quite as much interest in knowing who is to do it as they have in knowing what is to be done. In connection with a large structure recently completed, it was estimated as a result of pretty careful investigation that the building had directly and indirectly interested something over three thousand people in its construction, each one of whom received his instructions and final approval of work from the architect. Surely in a case of that kind the mention of an architect's name, no matter how publicly brought forward, could hardly be called illegitimate advertising.

The association of the name with the work may properly be carried even further. When a painter signs his canvas, or a sculptor carves his name on the pedestal of a statue, no one considers that he is exploiting himself before the public. It is expected as a matter of course, quite as naturally as that an author shall sign his writings. There has recently been considerable discussion as to the advisability of an architect's signing his buildings in precisely the same manner, not at all as a matter of advertisement, but purely as a matter of responsible identification, of properly locating the credit or the blame. While the species of advertising which some of the members of the profession are willing to resort to is anything but self-respecting or desirable, an architect's name should never be dissociated from the work he has produced, and as a matter of justice as well as of news, when the building is mentioned in print the architect's name belongs with it.

BRICKS WITHOUT STRAW.

THE inadequacy of means to desired results is one of the discouraging phases of all the arts and sciences, and no less is the insufficiency in the burnt-clay industries apparent to-day than it was in the time of Moses, with the difference that in the light of modern experience, for straw we must read dollars and cents. Or, to drop the simile, there is no difficulty in having good brick and terra-cotta work made. There are plenty of manufacturers to-day who can turn out what is wanted. The lack is not in the brains of the manufacturers nor in the processes of making, but in the amount of money which is available to pay for the product when completed. When an architect or an owner says he is discontented with terra-cotta as a building material, or feels that it is not sufficiently dignified to serve as a medium for his ideas, we will venture the broad statement that in nine cases out of ten the difficulty is rather that he is not willing to pay the price of a thoroughly good article. If our constructors were willing to pay for terra-cotta at the rate they do for stone, the resulting product would be equal to any artistic emergency. It is not fair to the product to put forward as one of its merits that it is cheaper than stone. Certainly most terra-cotta is cheaper than some stone, but burnt clay at its best, fresh from the hand of the artist, with every touch and feeling translated into permanent shape, should be measured for itself entirely irrespective of what it costs, and in planning for specific effects the cost of itself should be the last thing to be considered. Rather, let us try to get first the best effects in the most natural and straightforward manner. Terra-cotta when rightly used is never cheap, either figuratively or literally. The amount of thought and work which can be expended upon the modeling of a single ornament places it entirely above the category of ordinary work. We are appreciating this more and more fully every day in our country; but if one wishes to appreciate that we are trying to get good effects

in terra-cotta without paying the price, and that it is very largely the lack of adequate financial resources which prevents us from elevating terra-cotta to its proper level, one has only to compare the best of our work with buildings like the South Kensington Museum, or the London Natural History Museum. In our American work there is every evidence that our manufacturers know how to make the terra-cotta; but there is also, unfortunately, the evidence that terra-cotta is still suffering from the stigma of being a cheap material, and that in only too many instances our constructors and designers are not willing to give it the same chance that they would without question accord to stone.

WE have received the reprint of a paper upon the subject "Can Buildings be Made Fireproof?" which was presented to the American Society of Civil Engineers by Mr. C. T. Purdy, who is so well known for his excellent work in the lines of architectural engineering that his conclusions have very considerable value. The Pittsburgh fire is the text of the paper, which is very fully illustrated with diagrams and photographs showing the construction of the various buildings involved. Mr. Purdy's opinion is that, limiting the definition of fire-proof building to denote one which will not burn, no matter how great a fire it may be exposed to from without, and which will confine an internal fire to any room in which it occurs without material injury to the rest of the room, the Pittsburgh fire confirms the opinion that buildings can be made fire-proof; but that it is quite essential in making a fire-proof structure which can be depended upon in any emergency, that the best design, the best specification, and the best workmanship in every detail of the construction should be insisted upon. He also concludes that, as now manufactured, porous tile or terra-cotta fire-proofing can be relied upon to protect the steel construction, while the hard-burned material cannot be depended upon with the same certainty. Woodwork covered with wire lathing and plastering is not fire-proof construction, and the efficiency of concrete in floors was not tested by this fire.

WITH this number the translation, by Mr. Dillon, of Choisy's "The Art of Building Among the Romans" is completed. Of this work there remains four plates that have not been published. Subscribers who so desire may have these plates sent with the February number of THE BRICKBUILDER by sending notice to that effect to this office.

PERSONAL AND CLUB NEWS.

FRANK F. WARD and Herbert E. Davis have formed a copartnership under the firm name of Ward & Davis, for the practise of architecture, with offices at 203 Broadway, New York City.

AT the invitation of Mr. Frank Lloyd Wright the members of the Chicago Architectural Club met on the evening of November 29, in a discussion of the "Arts and Crafts."

THE St. Louis Architectural Club held its regular monthly meeting on Saturday night, December 4. President Ittner presided for the first time since the club's vacation. The names of Messrs. E. G. Garden and W. S. Eames were proposed as honorary members. The classes in architecture under R. M. Milligan, and the pen and ink class of Mr. Enders are showing considerable interest in their work. The other classes have not become thoroughly organized yet.

THE regular monthly meeting of the New Jersey Society of Architects was held on Friday, December 3, at Board of Trade rooms, 764 Broad Street, Newark, N. J.

THE chairman of the committee appointed to confer with the Master Mason's Association of the city of Newark, which association requested a conference with a like committee from the society to adjust in general misunderstandings between the architects and builders, reported that the agreement that had been drafted at the last meeting had been finally adopted after minor changes were made.

A REGULAR meeting of the T Square Club was held on Wednesday evening, December 1, the subject for competition being "An Arrangement of Terraces and Steps." Mr. Wilson Eyre was the critic for the evening. First mention was awarded to David K. Boyd, second mention to Wm. C. Hays, and third mention to John Molitor. The award of medal and mentions for the second annual redesigning competition was also announced at this meeting, the drawings having previously been sent to New York, where they were judged by Messrs. John Galen Howard, Bruce Price, and Henry Bacon, who had consented to act as jury for this competition, and made the awards as follows: Gold medal to Horace H. Burrell; second mention to Samuel R. Davis, and third mention to Charles Z. Klauder.

ILLUSTRATED ADVERTISEMENTS.

THE accompanying illustration is of the Brewers Exchange Baltimore, Md., of which Mr. J. E. Sperry, of that city, is the architect. This building is executed in terra-cotta and brick from sidewalk to flag-pole, including a very neat entrance and vestibule, in which the former material is used throughout with highly creditable results.

The terra-cotta was executed by the New York Architectural Terra-Cotta Company.

Another beautiful fireplace mantel designed in brick and terra-cotta is shown in the advertisement of Fiske, Homes & Co., page vii.

In the advertisement of R. Guastavino, page xiv, a group illustration is made which shows the roof over St. Anthony's Chapel, at Washington, D. C., in process of construction. Heins & La Farge are the architects.

Harbison & Walker Company illustrate in their advertisement, page xxv, the Y. M. C. A. Building at Cleveland, Ohio; C. F. Schweinfurth, architect.

Number two of the descriptive series of the roofing tiles made by the Celadon Terra-Cotta Company, Charles T. Harris, Lessee, is given in the company's advertisement, page xxix.

The Philadelphia and Boston Face Brick Company illustrate one of their artistically designed brick mantels in their advertisement, page xxxi.

Examples of bond, showing blocks of the Gilbreth Seam-Face Granite laid up in two styles of bond, is illustrated in the company's advertisement, page xxxviii.

The American Schoolhouse. II.

BY EDMUND M. WHEELWRIGHT.

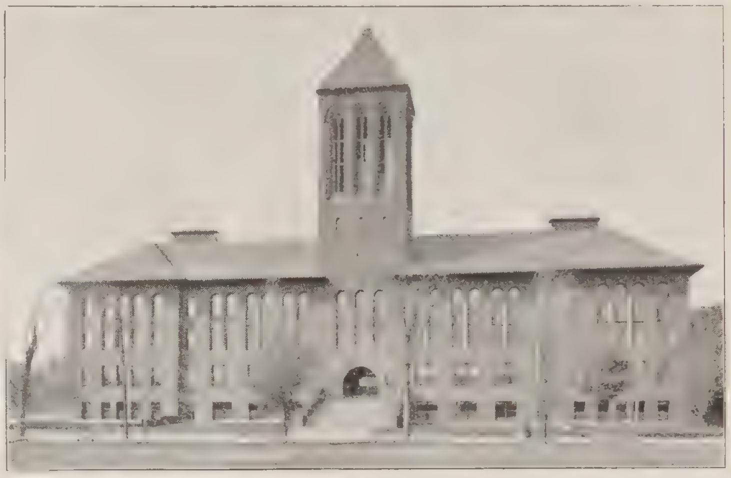
SLATE blackboards are the most economical in the long run, and, when of proper quality and color, are preferable to any other blackboard. All blackboards should be 4 ft. 6 ins. high. In primary schools they should be set 2 ft. 4 ins. above floor; in grammar and high schools they should be 3 ft. 0 ins. above floor. The chalk receiver should have a receptacle 2¾ ins. wide. It is desirable to have blackboards on all available wall surfaces of schoolrooms and recitation rooms.

Sheathed dadoes should never be used in schoolhouses. They give lodgment for dust, and when removed have often been found to be infested with vermin. The best dado for a schoolhouse is of gauged mortar, with wooden chair rail, where blackboards are not set, and with a plainly molded ogee base run out of 2 in. or 3 in. plank, or better, a like mold of Keene's cement may be used. To facilitate the cleaning of the building, it is advisable that the angles of walls and the junction of walls and ceilings of schoolrooms should be concaved on a radius, as is customary in good hospital construction.

As in a hospital ward, and for the same reasons, as little wood as possible should be used in the finish of a schoolroom. Inaccessible ledges on which dust may collect should be avoided. Jambs of windows and doors may well be finished with round corners in Keene's cement. The floors should be of rift Georgia pine or maple. Schoolhouse floors are not usually finished, although two coats of linseed oil for Georgia pine floors would appear as desirable here as in a private house for the floors that are to be scrubbed. School boards are usually very economical in expenditures for this purpose, a method of saving public funds not conducive to the health of the community. In Germany great pains are taken during construction to thoroughly oil the floors of schoolrooms, and the surface is carefully maintained in use. In Boston ash is found to be the most satisfactory of the inexpensive woods for the interior finish of schoolhouses.

The doors should have transom lights over them, and should have a glass panel set with bottom 4 ft. above floor. Doors should open towards the corridors. There should be a picture molding run around the walls of all schoolrooms, recitation rooms, and assembly halls.

A soft shade of light green is a good color for the walls of schoolrooms of the present standard size with southern exposure,



BROOKLINE HIGH SCHOOL, BROOKLINE, MASS.
Andrews, Jaques & Rantoul, Architects.

while light shades of buff are desirable for rooms with other exposures. No "hot" colors should be used on schoolroom walls. The ceilings should be tinted in light shades of buff. Water color may be used for all plaster above top of blackboard. If the narrower schoolrooms lighted from the left or from the left and right side are ever adopted, it would be possible to paint the walls of the rooms in a lower key than is now advisable where the rooms depend upon the general diffusion of light for their sufficient lighting.

Schoolhouses should have one or more teachers' rooms with toilet room adjoining, and in large schools there should be, in addition, a master's office.

The uses to which a basement may be put depends upon the size of the school. In every school, in addition to the boiler room, coal room, etc., there should be well-lighted play rooms for both sexes, with lavatories adjoining, shut off by fly doors with spring butts. Where sufficient size permits, manual training and cooking class rooms and gymnasiums for both sexes, and where possible, ample bathing facilities may well be provided. Where there is space there should be a well-lighted janitor's closet.

The best flooring for basement, corridors, play rooms, and lavatories is asphalt of the best brands. Where wooden floors are used, they should be laid on screeds bedded in concrete with waterproof paper under upper floor and with no air space. If the site is damp, it is advisable to lay on top of the bottom bed of concrete a thick coating of hot asphalt or tar concrete before setting the floor screeds.

BRIGHTON HIGH SCHOOL, BOSTON.
Edmund M. Wheelwright, City Architect.

It is a wise precaution to build schoolhouses of four or more stories in height wholly of indestructible materials, that is, they should be of "fire-proof" construction.

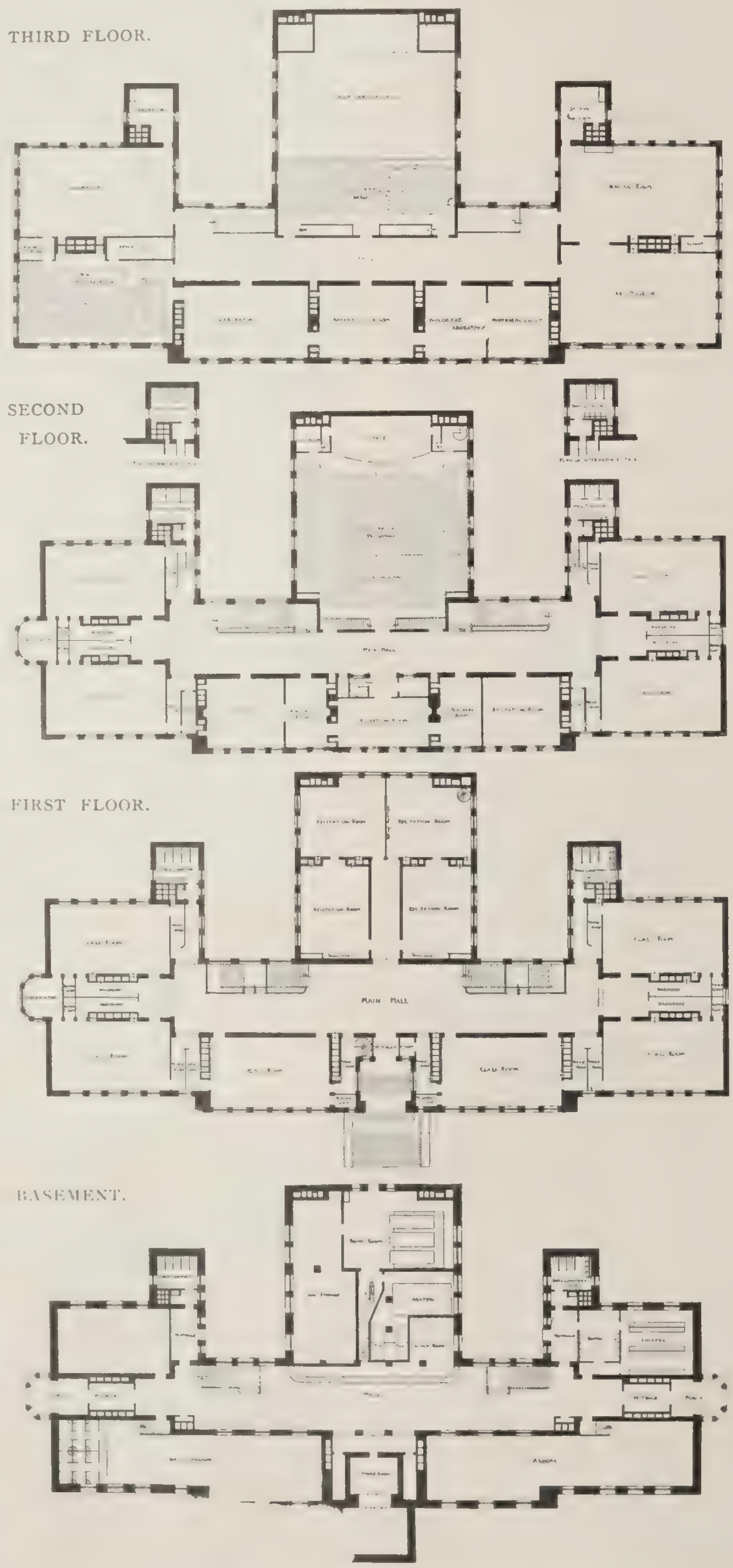
It would appear unnecessary under ordinary conditions to use such expensive construction in buildings of three stories or less in height.

The first floor of all schoolhouses should be of "mill" or "fire-proof" construction. With the present low cost of structural steel, a steel and arch construction of the floors is preferable to that of heavy timbers and plank, as the latter construction, though less expensive, is liable to cause considerable annoyance from shrinkage, as practically the market does not afford seasoned stock of large dimensions.

With the first floor constructed of incombustible or slow-burning materials, all interior partitions solid, the plastering laid directly on brick walls, ceilings wire-lathed and the basement staircase protected by fire doors, even if the floors above the first story and the roof are constructed of the ordinary narrow joists with ⅞ in. floor boarding, there is practically no danger from a fire started in the interior of a schoolhouse. If the roof is flat and protected by a battlement wall of ample height, under ordinary surroundings, a fire outside of such a schoolhouse would be a practical danger to the lives of the occupants. In a building constructed as above described, and in the isolated position of most schoolhouses, the scholars would be led to the street before there could be any dangerous condition of the building. There is, however, danger from panic. To avoid this danger by giving the greater sense of security to teachers and pupils, which goes with a solid construction, it would appear advisable to have the floors of fire-proof construction in primary schoolhouses in excess of two stories in height, when in closely built localities.

The inner lining of outer brick walls should be of hard-burned hollow brick, with soft brick set to receive nailings for finish. The interior partitions should either be of brick, terra-cotta lumber, or thin partitions of metal lathing on angle irons. The advantage of such solidity of construction and absence of wood furring is not only to protect from fire, but from vermin.

In the matter of schoolhouse construction the question of cost is an all-important consideration, and should be at least touched upon in a paper of this kind. An attempt at exhaustive analysis of the subject would be a task disproportionate to the value of the result. General conclusions drawn from data gathered in my own practise, and from that of others, may, however, prove serviceable to architects and school committees. This data should be used with judgment and with careful consideration of the conditions governing each particular case. Estimates based upon cost per square or per cubic foot can never be as safely relied upon as those based upon a survey of quantities, and reckoned according to the prices which maintain at a given time in each locality; but none the less a fairly close approximation of the probable cost of a building can be made by estimates based upon the cost per square or per cubic foot. The basis of cost per schoolroom is the fairest method of comparing roughly the cost of grammar or primary schoolhouses.



BROOKLINE HIGH SCHOOL, BROOKLINE, MASS.

To come to a closer judgment of such comparative costs that per cubic foot has often to be taken into account, while, as their plans present less constant characteristics than do those of the schoolhouses for the lower grades, the cost per cubic appears the fairest basis of comparison of costs of high schools.

The architects of the Brookline High School have allowed me to examine the drawings, specifications, contract prices of that building for purpose of comparison with the cost of the Brighton High School, built for the city of Boston. The two buildings were built at about the same time. Reckoned from the top of basement floor to top of cornice, the Brookline High School contains 1,193,880 cu. ft., and cost, without grading and without laboratory, or other similar fittings, $185,000, *i. e.*, close to 15½ cents per cubic foot. The Brighton High School contains 746,854, and cost upon the same basis in round numbers $122,000, or about 16½ cents per cubic foot, *i. e.*, the proportionate cost of the Brighton High School was 6.6 per cent. more than that of the Brookline High School.

By actual computation 4½ per cent. of this additional cost is explained by the extra thickness of walls and strength of floors required by the Boston Building Laws. As the Brookline school was an admirably constructed building, it will be seen that if the building laws of Boston had permitted, the Brighton school

might have cost between $5,000 and $6,000 less than it did. The Brighton school had slate blackboards, Keene's cement door and window finish, double run of sash above basement, asphalt floor, or equivalent, throughout basement.

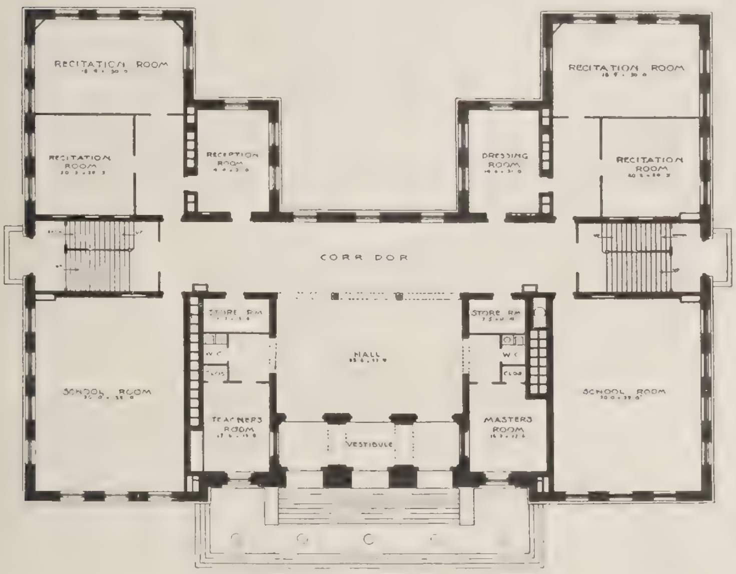
The Brookline school had composition blackboards, oak door and window finish, single run of sash throughout, basement floors of concrete or Georgia pine on concrete.

If the Brighton school had been finished as was the Brookline school, the following savings could have been made in the former building: —

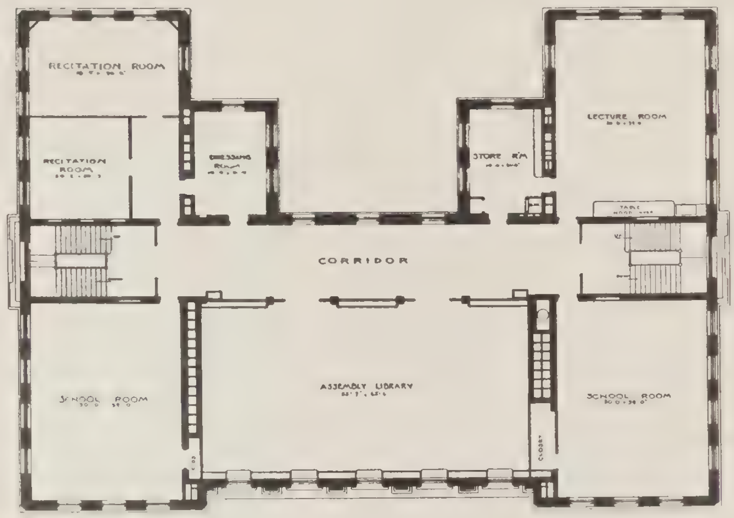
Wire lathed ceilings	$1,328.00
Terra-cotta lumber partitions	606.00
Hospital base	252.00
	$2,186.00

This is 1.8 per cent. of cost of the building.

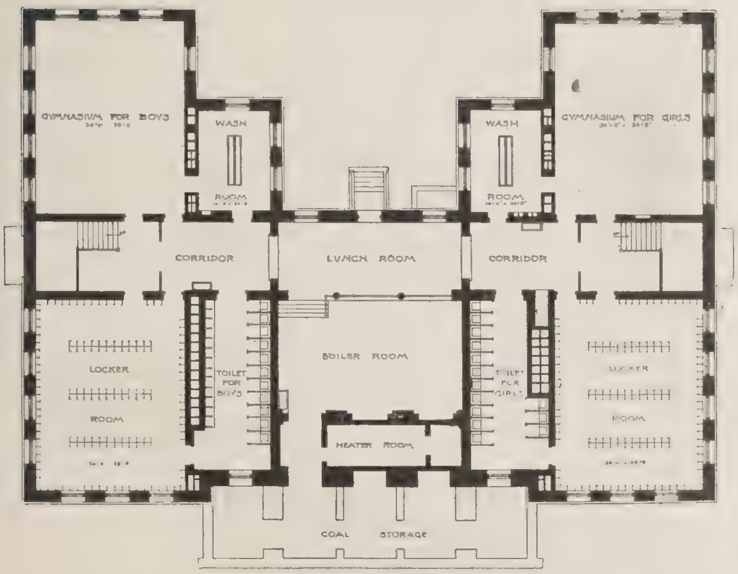
A careful computation of the cost of the Brighton High School shows that if the building had been built as a purely utilitarian structure of the factory type, a saving of 8 per cent. of the cost, or between nine and ten thousand dollars could have been made.



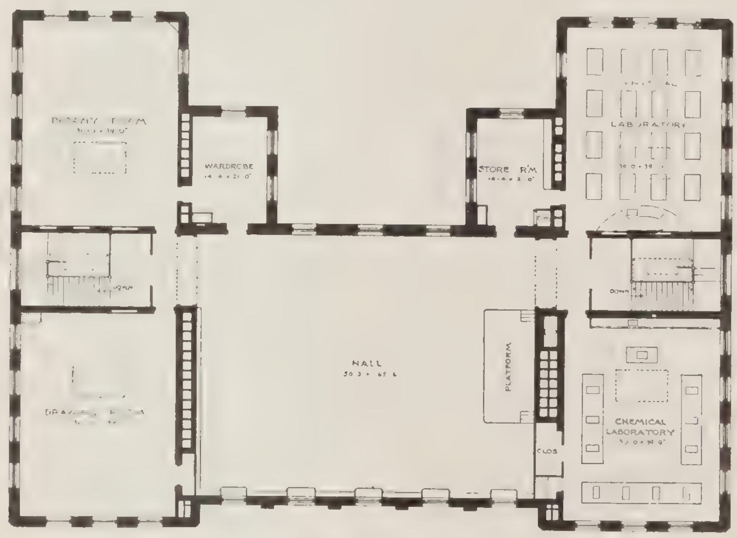
FIRST FLOOR.



SECOND FLOOR.



BASEMENT.



THIRD FLOOR.

Composition in place of slate blackboards	$537.50
Oak instead of Keene's cement finish	226.80
Single in place of double run sash	1,090.00
Concrete and Georgia pine basement floors in place of asphalt	654.00
	$2,508.30

This amount is a trifle more than 2 per cent. of the cost of the Brighton school. The features noted above were originally contemplated by the architects of the Brookline school; they were omitted to bring the cost of the building within its strictly limited appropriation.

The Brookline and Brighton schools had in common certain features not found in less well-constructed buildings, which cost, in the Brighton school, as follows: —

The architects of the Brookline school reckon the cost of tower above cornice line as being between $8,000 and $10,000, or about 5 per cent. of cost of the building. There are other architectural features in the Brookline school which increase its cost above that of a purely utilitarian structure. It is probable that a closer analysis of the cost of the two buildings would be about the same proportionate expense for architectural effect.

We may, therefore, safely set the cost of a first-class high school building at 15½ cents per cubic foot. This should apparently be the normal cost of such a building provided with domestic engineering systems of requisite excellence, if built in a locality where the requirements of the building laws involve no needless expense, and where the cost of labor and materials is as high as it is in the neighborhood of Boston.

Important Problems in Construction.

BY WILLIAM W. CREHORE, ASSOC. M. AM. SOC. C. E.

PROBABLY the greatest inconsistencies are found in the details of wooden construction. Girders and beams of ample carrying capacity often have insufficient bearing or rest on improper material. Framed joints between headers and trimmers are weakening at best, and are seldom made to develop the full strength of either member. Frequently these joints are so made as almost to incapacitate one of the members entirely. It is safe to say that architects, as a rule, pay little attention to the design of joints and connections in their wooden construction, but leave this important work to the boss carpenter, trusting largely to his experience. The scarcity of accidents in this kind of construction shows that the carpenter's experience is a valuable guide, but the inconsistencies remain, and much material is absolutely wasted, because it is used where its full strength cannot be developed. The use of iron stirrups in wood framing is becoming more general and ought to be encouraged; it does away with mortising, and thus not only preserves the full value of the timbers intact, but also saves time and labor in erection. The additional first cost is slight.

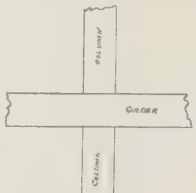


FIG 1

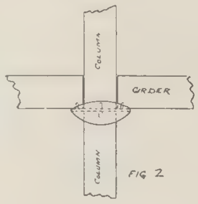


FIG 2

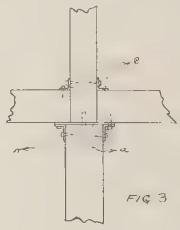


FIG 3

FIG. 4

It has long been customary in wooden construction to rest the posts directly on the girders which pass over the tops of the posts in the story below, as in Fig. 1. By this construction the direct column load crushes the girders across the grain where the timber has only about one fifth the resistance that it has against crushing longitudinally. Consequently, when the posts are figured to their full capacity only one fifth of it can be developed in any arrangement such as this. As a chain is no stronger than its weakest link, so it must be remembered the capacity of a structural system is determined by the weakest spot in the system. There are several devices in use for making these wooden post and girder connections; for example, see Fig. 2, where the post above rests on a kind of cast cap between it and the post below, the sides of this casting being extended to receive the girders. These connections are very loose and do not bind the adjacent members together in any way, their avowed purpose being to "let go" easily in case of fire or accident.

FIG. 6.

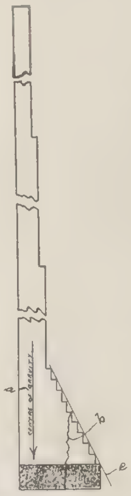


FIG 5

The connection shown in Fig. 3, however, possesses superior advantages to the cast cap. A steel plate, a, is placed between the columns and may be extended in two or more directions to receive girders. A pair of angle knees, b, is placed under the girders and made fast to the lower column by lagscrews. Lagscrews also pass up through the angles and the plate into the girders, thus securing the whole system from shifting in either direction. The upper column is held laterally by the ends of the girders in one direction, and to prevent motion the other way a wooden peg is let into the lower column and passes up through a hole in the plate into the upper column; to increase the rigidity of this connection a pair of angles may be used at c also, with lagscrews into the column and girders. By properly proportioning the size of the steel plate and angles, this simple connection can be made to fit any combination of wooden girders and posts imaginable. The writer has used it with 12 by 12 girders connecting to 8 by 8 posts with no difficulty whatever. Then, too, each girder and post has a square cut end, and no side straps are required to hold the girders in place. Heavy wooden construction might be safely used with this style of connection, if properly proportioned, in many cases where cast-iron columns are now used with wooden girders.

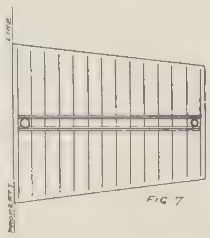


FIG 7

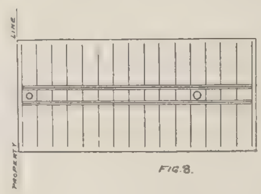


FIG. 8.

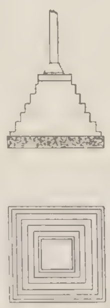


FIG. 9.

FIG 10.

In determining the extent of bearing to give to wall or column footings on different kinds of soil, careful attention should be paid to the old rule about keeping the center of gravity over the middle third, and on soil of a yielding nature still greater accuracy than this is required. If a rigid slab of any kind be laid on a plastic or yielding surface, and a pressure be exerted at some point outside the middle third, the slab will be observed to take a permanent set in an inclined position, lower at the loaded end than at the other, as illustrated in Fig. 4. Similarly, then, but on a larger scale, when a wall is so built and stepped off that the center of gravity of its section falls outside the middle third of its footing course (see Fig. 5) the same phenomenon must be expected, if the footing course is rigid; otherwise the footing course must crack off on or near the line, b, which separates the working portion from the idle portion.

This emphasizes the point that a portion of every such footing is idle, and of no effect, or rather, that its effect is bad in proportion to its rigidity, because its tendency is then to assume an inclined position, like the experiment in Fig. 4, and thus cause cracking in the back of the wall at some point about a (see Fig. 5); whereas if the footing course could crack, the loaded portion would move on down vertically and the idle portion stay where it was. Besides this "middle third" principle, there is the "sixty-degree" principle, which requires that a straight line, c, inclined so as to touch the corner of each step shall make an angle with the horizontal of not less than sixty degrees. This limit of inclination has been established from theoretical considerations as well as by experience, and its observance is a prerequisite to stability in construction. "Problems in construction are all simple enough if you keep in mind two things,— bracing at forty-five degrees, and brickwork at sixty," was a remark made not long ago by an architect who is better known for his artistic ability than for his knowledge of construction. As emphasizing fundamental principles the remark is worth recording and remembering.

The writer may be pardoned for this digression into the realm of first principles, in view of the surprising number of violations of these principles which have been observed to exist in actual work and in plans for proposed new work. The advent of higher buildings and the novelty of all problems connected with their construction, has led some designers to try experiments with first principles to a remarkable extent. To illustrate from an actual case, take Fig. 6. The designer found the side wall loads would require wider footings than he could obtain by stepping up in the usual manner on one side of the wall only, and being reminded of the universal efficacy of steel beams for an emergency decided to imbed a series of them in the concrete under his footings (as shown to scale in Fig. 6), and thus distribute the wall load over the required amount of ground without destroying his interior with stepped-up footings. In effect he simply had a perfectly rigid footing, part of it loaded (rather overloaded) and part of it idle, so that in case of settlement the condition in Fig. 4 will prevail, eventually producing a horizontal crack in the back of the wall.

A large part of the difficulty experienced by designers is due to the necessity for providing for isolated heavy loads at or near the

property line. If it is not possible to arrange the footing so that the load's center of gravity will fall within the middle third of the ground area covered, then it may be tied to another in one rigid bed of steel beams encased in concrete, spreading over enough ground to carry both the loads, and occasionally one bed is made to receive three or four or more loads. In designing one of these grillage beds it is important (1) to shape it so that the center of gravity of all the superimposed loads shall coincide nearly with the center of pressure of the ground area covered, and (2) so to design the grillage itself that it will distribute the imposed loads equitably over every square foot of the ground area. To bring about these results is not as simple a problem as it might at first appear, especially if there are more than two loads, and if their relative positions and magnitudes are irregular.

In the case of two loads on one grillage bed, if the interior load is lighter than that on the property line, the bed should be trapezoidal in shape (see Fig. 7), but if the interior load is heavier, the bed may be rectangular (as in Fig. 8). These requirements arise from the necessity of keeping the center of gravity of the loads coincident with the center of pressure of the area covered by the grillage bed.

The simple square grillage bed (see Fig. 10) for a single interior heavy or moderately heavy load possesses advantages over the stepped-up masonry footing (see Fig. 9) covering the same ground area in that there is much space saved about the column near its base which is lost in the stepped-up footing, or else the latter has to be lower in the ground. At the present prices of steel beams the slight difference in cost is offset by the saving in brickwork and by this gain in space or saving in excavation.

In order to distribute an isolated load or loads over the grillage bed an upper course of steel beams or girders is usually necessary. In the lower course or grillage course proper the beams are laid not more than 12 or 15 ins. center to center, and the concrete between them is depended on to complete the distribution on the ground. In the upper course the problem is to receive the loads from the columns and to distribute them as economically as possible over the lower grillage beams. For this purpose deep beams, or plate girders if more economical, are placed close together directly under the load or loads and extended across all the beams of the lower course. The total bending moment having been figured, it will be found much more economical to make it up by using a few deep beams concentrated under the load than to use many shallow beams spread out over the lower grillage, even though the projecting portion (and therefore the moment) of the lower beams is thereby made somewhat less. In the lower course it would also be more economical to use the deeper beams if they could be spaced further apart, but the close spacing is necessary here to make the distribution of the loads complete.

In the writer's opinion this whole subject of load distribution should receive more attention from designers than is now customary. It is not a feature of high building construction only, but should also be thought of in designing footings for lighter loads as ordinary dwellings. These footings are too often specified arbitrarily without any calculation, and made like some other case where the conditions are supposed to be similar. There are very few kinds of soil that will not bear *some* weight without yielding; it is merely necessary to find out how much or how little the soil will bear on each superficial foot and then to design accordingly with a fair factor of safety. In building a frame house on more or less spongy ground stability will be gained by spreading the footings over an increased area sooner than by sinking them deep, unless solid ground is to be found near at hand. The architect or builder of your suburban residence tells you that it will take a year or two for your house to settle, and that you must expect ceilings and walls to crack, windows to bind, and door jambs to be distorted from rectangles to parallelograms, necessitating frequent visits of the carpenter and the locksmith. This, on the contrary, is not necessary, and a very slight extra expense in the footings to begin with would prevent all the above and similar annoyances which were not directly due to the use of green lumber in constructing the building.

Architectural Terra-Cotta.

BY THOMAS CUSACK.

(*Continued.*)

THE recently erected Bank of Commerce, Cedar and Nassau Streets, New York, of which Mr. James B. Baker is the architect, has been appropriately named; for it certainly is a commercial building *par excellence*. This is indicated, not only by its location and the avocation of its occupants; the design itself would seem to have been suggested by a full and frank acceptance of these underlying facts, as the fundamental conditions on which the embodiment of that idea should be based. So, too, with the detail, which has been worked out on really sensible business principles, enlivened

FIG. 45. BANK OF COMMERCE BUILDING, NEW YORK CITY.
J. B. Baker, Architect.

on the one hand, and held in due subjection on the other by good architectural maxims. It is legible, and on the whole, effective, when viewed from any point of accessibility in a neighborhood where tall buildings now "do congregate." There is a commendable absence of unnecessary fripperies, as also of finical bedizenment, and there is reason to doubt whether the designer cares two cents for triglyphs. Judging not merely by what has been done, but quite as much by what has been wisely left *undone*, in the way of detailing here, we think that common sense has prevailed over pedantry, for which we are disposed to feel thankful. The legibility, and much of the effectiveness just referred to, is accomplished chiefly by a systematic gradation in the size of the various members. They increase in size, just as the ornament increases in boldness of relief, in proportion to its approximate distance from the spectator. In that respect, at least,

we have in this building a timely reminder of an oft-forgotten and in some instances, apparently unknown art, which should not be allowed to pass unimproved.

It is matter for regret that as much cannot be said in behalf of the color scheme, more especially so in regard to the combination

FIG. 46.

of color as between terra-cotta and brick walling. The three lower stories are granite of a bluish cast, for which the terra-cotta through out is a remarkably good match. This is so, not only in color, but in the quality of surface texture, which it is more difficult — and, beyond a certain point, obviously impossible — to produce. The constituents of that unstratified rock, quartz, feldspar, and mica, though in itself of volcanic origin, cannot be reconstructed by fire without the admixture of other and more fusible ingredients. In combination with silica and alumina, etc, they may be rendered more time resisting than the original rock, but they no longer retain their crystalline formation.

The word match is used here out of deference to those who prefer to regard it as such; but *imitation* is the more correct word, and it, like Banquo's ghost, will dog our steps at all hours, whatever we may do to down or disguise it. The more general question of imitating stone will not be shirked when the time comes to discuss it, but in passing let this much suffice for the present. It is done by manufacturers in response to a demand that is well-nigh irresistible, because usually urgent, sometimes peremptory, and not infrequently a condition precedent to the closing of a contract. When that demand ceases or abates in its insistence, so will the supply, but not, we fear, until then. The root of this abnormal growth was exposed not many days ago by a prominent architect, who, in reply to a mild remonstrance on the point by the present writer, remarked in a tone of unavailing regret, "Your argument is all right in theory, but the tide is against you; I have found it so in my own practise." The remark, no less than the confession, showed that he, too, though an architect, was content to remain a creature of circumstance. Nevertheless, in the present instance, as in others just like it, we cannot help thinking that a solid body color in a gray burning clay, adjusted to about the required shade by an admixture of a small percentage of manganese, would have been preferable to the one selected. It would, at all events, have avoided the appearance, and left never a foothold for the charge, of artificiality.

The brick used from the fourth to the fourteenth story (inclusive) are a light buff with a yellowish tinge. This, with the horizontal bands of dark terra-cotta, destroys the idea of vertical homogeneity which is (or, we think, ought to be) the dominant characteristic of a high building. The contrast is also more pronounced than agreeable. There is such a thing as a harmony of contrast, and though that was the thing evidently aimed at here, we leave it for higher authorities on color to say whether the mark has not been missed by several points. Instead of harmony, it appears to approach the margin of that neutral territory, beyond which discord begins.

In Fig. 45 we have a view of such portions of the Bank of Commerce as rise above the Equitable Life Building on the left, and the Mutual Life on the right, with a rear view of Mr. Post's twenty-five-story bantling in the distance. The lower stories disappear from view in the depths of the Nassau Street Canyon, where our lens, by reason of physical limitations, was unable to penetrate. We know for a fact, however, that they rest on a secure foundation of steel, buried in a monolith of cement the size of the entire site, and many feet in thickness. With this assurance, we can now give undivided attention to the four upper stories, on which may be noticed an excellent example of engaged columns of the banded variety, a style that is invariably successful in terra-cotta. Losing sight of all that is below, these four stories and the main cornice, Fig. 46, undergo a favorable transformation, and that because their continuity is not so much broken up by the intrusion of harshly contrasting brickwork. The bluish-gray monotone, however, remains; and whether viewed from the harbor or from adjacent housetops, we

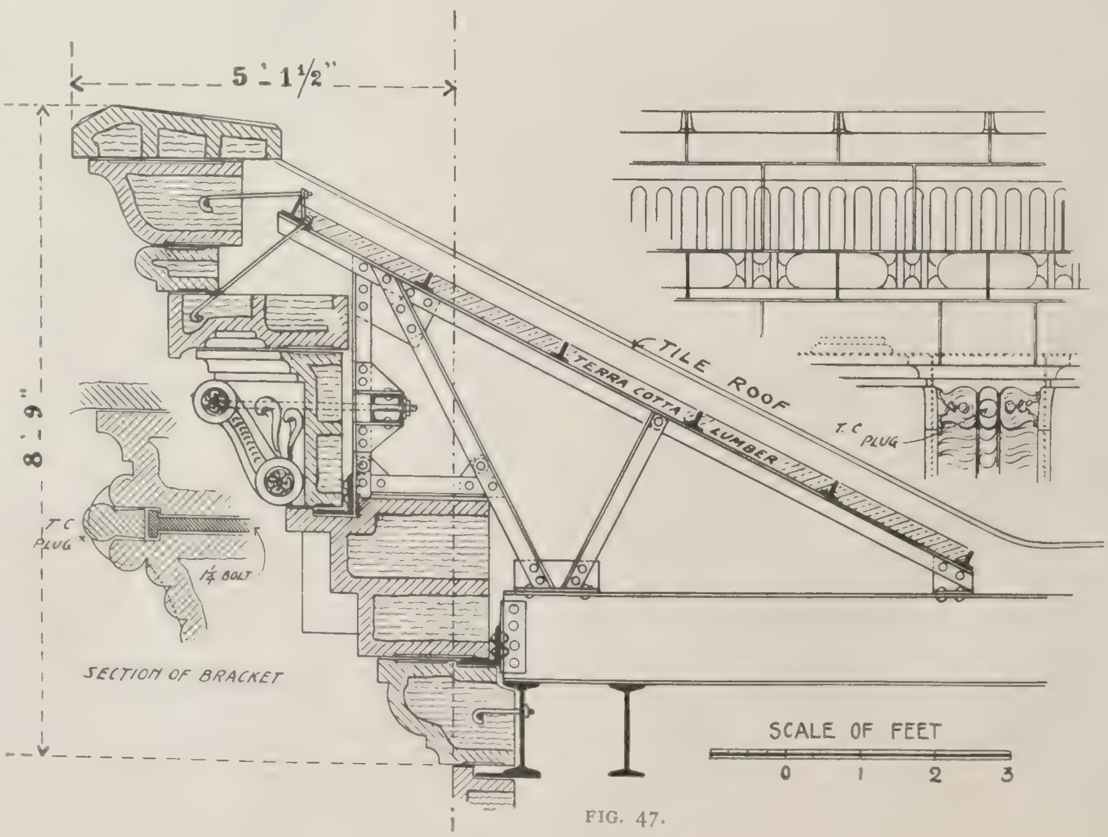


FIG. 47.

think it must be admitted that the color is more than one shade too dark. A lighter color would have yielded a greater proportion of high lights, between which and the deepest shadows there would have been a blending of half-tones to unite the two extremes and preserve an even balance. The absence of this scintillant transition is not felt so much in a strong light when tinted by "that silent architect, the sun"; but under a leaden sky, or when the shades of evening begin to fall, the general effect leans too much to the side of monotony and gloom.

The main cornice, Fig. 47, has a height of 8 ft. 9 ins., and a total projection of 5 ft. 1 in. from wall line; and, as little of its weight rested directly on the wall, it had to be transmitted to the structural framing and to the roof beams. This is done by a series of steel trusses, framed out of 3 by 3 L sections and spaced on about 5 ft. centers. The direct weight of the first course has a partial bearing of about 10 ins. on the wall below, and besides fitting into the flanges of the 15 in. I beam, it likewise rests on the projecting bottom cover-plate. It is also anchored back by a ¾ in. bolt, one end of which takes hold of a ¾ in. rod that passes through the block, the other having a tension nut, by means of which the desired alignment is made, thus overcoming any trifling variation that might occur in the ironwork.

The dental course rests, in part, on a continuous 6 by 6 L section attached to floor beams. On the top bed of these blocks a recess is molded, into which another continuous 6 by 6 channel is bedded, and then riveted to the triangular bracket forming part of the main truss. It will be seen from this that the whole course is held in position in a simple, practicable way, and beyond the possibility of escape. Into the seat thus prepared the modillions are set on about 2 ft. 8 in. centers, and they, in turn, are secured by a 1¼ in. bolt, which, passing through the block, is fastened to the two channels in the manner shown in section. The flat head of this bolt is countersunk, the hole being then filled by a terra-cotta plug, set in cement, the outer end of which becomes one of the balls called for in design of modillion baluster.

The modillions being thus secured beyond peradventure, and the panels between them locked in position, they are made to act as corbels, with sufficient strength to carry the four courses above, and yet leave a wide margin of safety. In these last courses, as with the first one already described, a hole is provided for a ¾ rod to pass clear through the block, from which it may be anchored at convenient intervals, without reference to positions of joints. The coping is set on a liberal bed of cement, which, passing up between the partitions of the cellular bottom bed, grips it in such way as to make anchors unnecessary. The sloping roof is formed of fire-proofing, on which is laid a waterproof covering, to be again protected by a tile pavement laid in cement. The risks of fire and water reduced to a minimum, the damage from incessant friction is rendered practically non-existent.

The construction and execution of this cornice has been spoken highly of by men well qualified to judge of its merits. From their conclusions we see no reason to dissent in any particular. It is a good example of its kind, with a projection in due proportion to its height, and quite sufficient as the crowning member of a twenty-story building. Most important of all, we think it is safe, which is more than can be said in the case of all the terra cotta cornices of recent erection, with which we are acquainted. There may be things in this world about which "ignorance is bliss," but the security of overhanging members, suspended at heights varying from one to three hundred feet, in a city's most crowded thoroughfares, finds no place in that category. Some day, we fear, there may be a tale to tell on this subject, in regard to which those who had furnished the sensational features would be cited as involuntary listeners. The meritorious examples that have been selected for discussion may, in some measure, help to encourage and promote the construction of others equally good. In this, the one thing required is an intelligent application of the same (or similar) principles, honestly applied and modified to meet the exigencies of the subject in hand.

The Art of Building among the Romans.

Translated from the French of AUGUSTE CHOISY by Arthur J. Dillon.

PART III.

CHAPTER II.

THE ART OF BUILDING AND THE ORGANIZATION OF THE WORKING CLASSES.—(*Concluded*).

THE number of monuments built by the Roman troops was considerable. It was one of the Roman principles that the soldiers should never, under any circumstances, remain idle; and, as must be confessed, it was principally to avoid dangerous inactivity that they were employed on the buildings, and frequently they were thus employed, the Roman writers tell us, on buildings which were otherwise superfluous. When Vitellius had the amphitheaters of Bologna and Cremona built by the soldiers, he thought less of bestowing on the cities these useful buildings than of controlling for the moment the turbulent spirit of the legionaries. In Africa we again find the Roman soldiers building amphitheaters; in Brittany, fortifications; in Egypt, tombs, bridges, temples, porticos, basilicas; in Italy, the great roads, and everywhere the mention of their work is accompanied by the curious observation that "the monuments were undertaken in order to occupy their leisure."

It was not only the soldiers that were thus transformed into workmen, for such was the simplicity of the Roman methods that even the prisoners that the Romans held and the convicts from the lowest ranks of the people could be used for the same purpose. Condemnation to labor on the public works was a recognized legal penalty. It is cited by Paulus, and may be read on every page of the Theodosian legislation.

The work was principally in extracting the material for buildings, and it was from among the prisoners, principally the Christian prisoners, that the workmen were recruited who quarried the stone and dug sand for the Baths of Diocletian; and long before, all the prisoners of the empire had, under different pretenses, been put to work on the canal of Avernus, as well as on that colossal assemblage of palaces called the House of Gold. "To complete them," says Suetonius, "all who were in the State prisons were brought to Rome by the order of the emperor, and he did not allow those convicted of crimes to be sentenced to any punishment except labor on the public works." [1]

The Romans even went still farther. Not satisfied in placing prisoners and soldiers side by side with the workmen, they even called to the work of construction free citizens and men most unused to work, demanding of the one, materials, of the others the aid of their arms. This unusual but systematic imposition was particularly developed toward the seventh century along with the rise of despotism, and it was continued under varying names until long after the fall of the empire. But in order to see things from the proper point of view it is necessary to go farther back.

The Roman idea of taxation was entirely different from that held to-day. People were then divided into two distinct parts; one was the urban population, who as a whole had the benefit of the rights of the cities and of the municipal franchises; it was composed of descendants of the ancient Roman colonists, men of the race of conquerors, as could be seen by their liberties and privileges. Beneath this class was the taxable population, the remains of the indigenous race, which was constrained to provide for the other half

[1] The texts establishing this participation in public works by prisoners are these: —

Paul., Sentent., Lib. V., tit. de Poenis; Cod. Theod., Lib. XIV., tit. X., l. 4; Digest., Lib XLVIII., tit. XIV., l. 34, l. 8, § 7, etc.

On the construction of the Baths of Diocletian with the aid of convicts: Annales eccles. Baronii, ann. 298, act. Sta. Marcelli.

Construction of the House of Gold and of the canal of Avernus: Suet., Nero, Cap. XXXI.

of the empire by its labor. The imposts they paid were not only taxes to cover the cost of the government; they were also, in fact above all, tribute paid to the luxury and subsistance of the great cities. This fact alone establishes the great difference between the social economy of antiquity and that of to-day. The difference is, however, not only in the destination of the results of taxation, for it is even more apparent when the elements which made up the public revenue and the manner of its collection are examined.

This tribute, which was imposed on the vanquished, should have been redeemable, as with us, in money, which could then be exchanged for the necessities of the conquerors; but the interposition of money seemed a useless complication to the Romans, and instead of obtaining the products of the soil and of labor by the use of money exacted from their tributaries, they preferred to suppress all such intermediaries and collect the debts of the provinces in such shape that they could be immediately utilized; so a large part of the taxation was collected, not in money, but in kind, and those who were responsible for the provisioning of Rome were, in most cases, the collectors of these curious taxes.[1]

Building materials were among the taxes in kind which the Romans thus collected. For example, the curiales of Etruria paid annually to Rome 900 cartloads of lime; the city of Terracina had a similar impost to pay, and the product of these taxes was reserved exclusively for public works, lighthouses, wharves, etc. Such and such a country sent the Romans building stone, another a tribute of bricks. These materials were a percentage of the products of various industries, just as in certain provinces (among others Bruttium and Calabria) a part of their flocks and herds, and from Egypt and Sicily a portion of their wheat was taken. Distinct regulations, moreover, prohibited the acceptance of an equivalent in money, and thus guaranteed to the public works supplies of material whose amount was limited only by the moderation of the Romans.[2]

It was in this manner that the owners of the soil assisted, by contributions of taxes in kind, in the establishment of public edifices. As for the lower classes, whose almost total lack of property sheltered them from taxes either in kind or in money, they owed to the public works a tribute of another sort, forced labor.

The corvée played an important rôle in the public works of the last centuries. The Romans disdainfully called this form of tax "sordida munera," and counted among the services that could be demanded of that part of the population subject to forced labor, the proportion of the lime for public works and personal concurrence in "the construction of the public monuments, the sacred buildings, and the great roads of the empire." The people[3] who took part in these works were in principle all the inhabitants of the empire, except the officers of the government, and the dignitaries of the church, and the army. Nevertheless, the exceptions should have been greater in practise; and judging from appearances, it is probable that the Roman authority excepted all the population of the great cities from whom they provided provisions and pleasures, and from whom, it would seem, they were far from exacting onerous assistance or useful services.

It remains to say how these taxes were imposed, what recourse there was against their exaction, and what laws determined their extent and tempered their rigors. But, with a remarkable gap, the Code leaves these serious questions in the most absolute vagueness. More than twenty[5] constitutions relate to the "sordida munera," and among so many laws there is not one which defines the rights and obligations of the subjects of the empire, who came within the scope of these onerous regulations; all treat of the exceptions, the only thing which they neglect to define is the extent of the obligations which they impose. Thus is seen, even in the silence of the law, the spirit of a system which was based entirely on exceptions and privileges. This gap in the laws left open an unlimited field for arbitrary and oppressive measures, and the frequencies of the corvées under the rule of the emperors shows the strangest forgetfulness of equity in the distribution of the public burdens. Taxes in the form of personal labor have, among other wrongs, that of being imposed exclusively on those taxpayers who, by chance, happen to be in the vicinity. But the Roman emperors hesitated but little over principles when it was a question of a tax that fell on a class of the people who had been reduced, by centuries of servitude, to passive instruments. These general levies were a sure and swift means of attaining their object, and this advantage was sufficient for them. They had frequent recourse to it during the despotic times that preceded the dismemberment of the Roman world. It was by this means that Diocletian was able to execute, in so few years, the embellishment of Nicomedia, of which he wished to make a second capital of the empire, and a rival of ancient Rome. Basilicas, palaces, a circus, a mint, an arsenal, were raised in the new city by the unaided arms of the inhabitants of the city. They were compelled to transport the materials at their own expense, to furnish all the necessary engines and machinery, and even to cede to the emperor the sites of their own houses. These requisitions, of which Lactantius has left us so striking a picture,[6] were so unexceptional in the eyes of the Romans that one of their historians eulogizes Vespasian for having constructed buildings in the provinces "without having taken laborers from the fields."[7] The whole spirit of antiquity is shown by this single remark, which becomes even more characteristic when it is considered that it relates to one of the most prosperous periods of Rome and to one of the best princes that ever ruled the empire.

To sum up: Rome took its unskilled labor from the population subject to the corvée, and its skilled workmen from the local corporations; the corvée and the corporations were the two elements which supplied the labor for the construction of those monuments whose ruins we admire; to unite them was to unite material power and the strength of tradition and to furnish the empire with resources sufficient for the most colossal undertakings. But as they owed their existence to a false organization of society, these resources were rapidly dissipated, and the empire finally experienced the fatal results of an economic system founded on disregard of individual right and private liberty; the country supported during three centuries the painful laws which compelled it to construct for the cities buildings of a purely municipal character; the small towns themselves were put

[1] The details preserved in the Theodosian Code, Lib. XIV., tit. IV., on the organization of the "Suarii" should be examined in this connection. I chose this example because these tax collectors, who were also counted among the principal contractors, are perhaps those whose functions were most clearly defined: and from this point of view, a study of their organization should precede any general research on the method of collecting the taxes in kind among the ancients.

[2] Tributes of lime paid by Etruria and Terracina: Cod. Theod., Lib. XIV., tit. VI., l. 3; Symmach., lib. X., cap. 53.

Tributes paid in building stone: Cod. Theod., lib. XIV., tit. VI., l. 4.

Tributes paid in brick. See the notice published by Nardini at the end of his "Roma Antica," designated "Lettera d'Ott. Falconieri sopra l'iscrizione d'un mattone," etc.

Rule against the acceptance of money in place of tributes in kind: Cod. Theod., Lib. XV., tit. I., l. 17.

No part of these materials was conceded to individuals unless the portions paid by the tributaries exceeded the limit of the public needs: Cod. Theod., Lib. XIV., tit. VI., l 4.

[3] Cod. Theod., Lib. XI., tit. XVI., l. 15. 18. The list of the taxes varies greatly. To show this it is sufficient to compare the enumeration of the fifth century in the Theodosian Code with that in the Justinian Code of the sixth century (Lib. X., Cap. XLVII., l. 12). There is a direct proof of these variations; for example, that the care of the great roads ceased to be placed among the "sordida munera" under Theodosius the younger. But these fluctuations of the Roman law are of little importance, for we are more concerned with the general idea than with the details of its application.

[4] Cod. Theod., Lib. XI., tit. XVI., l. 15, etc.

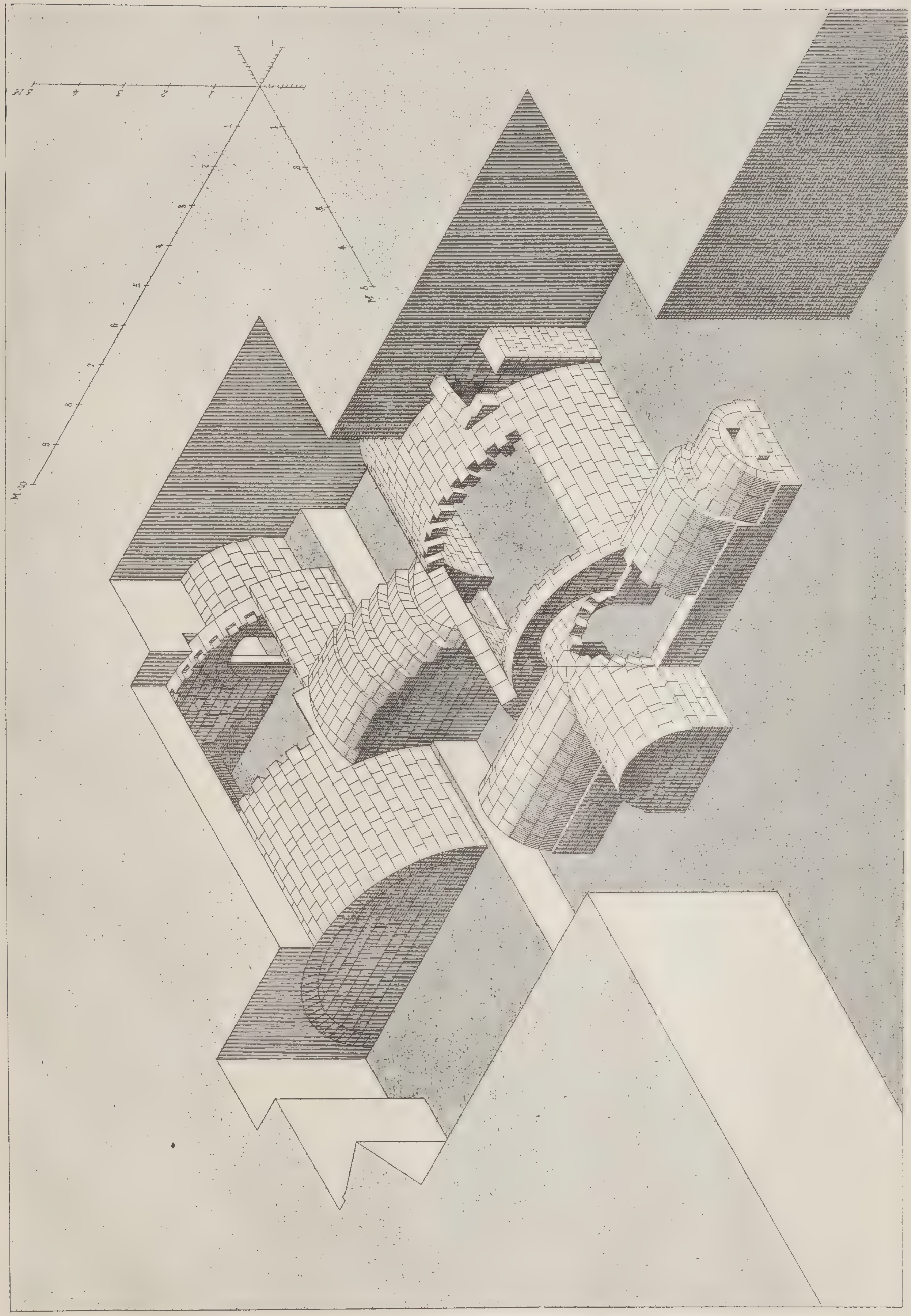
[5] It is necessary to make a careful distinction between the "sordida munera" and the "extraordinaria munera." The two kinds of contributions, although the juridical texts frequently connect them, were, by their nature, profoundly distinct. The Theodosian Code never confounds them and sometimes it even opposes them, as can be seen in Lib. XI., tit. XVI., l. 15. "Sane rerum extraordinariarum munus ab omnib. omnino Magnif. tua sciat esse poscendum . . . . Sordidorum vero munerum talis exceptio sit, ut . . ."

The "sordida munerum" were the corvées, the "extraordinaria munera" were simply increases of taxation. It will be remarked that there were much fewer exceptions to the "extraordinaria muneria" than to the "sordida muneria"; but, on the other hand, their imposition was guarded by a host of guarantees, none of which extended to the "sordida munera." See, in support of this observation, the following constitutions where the "sordida munera" appears, and whose character is defined by their assemblage.

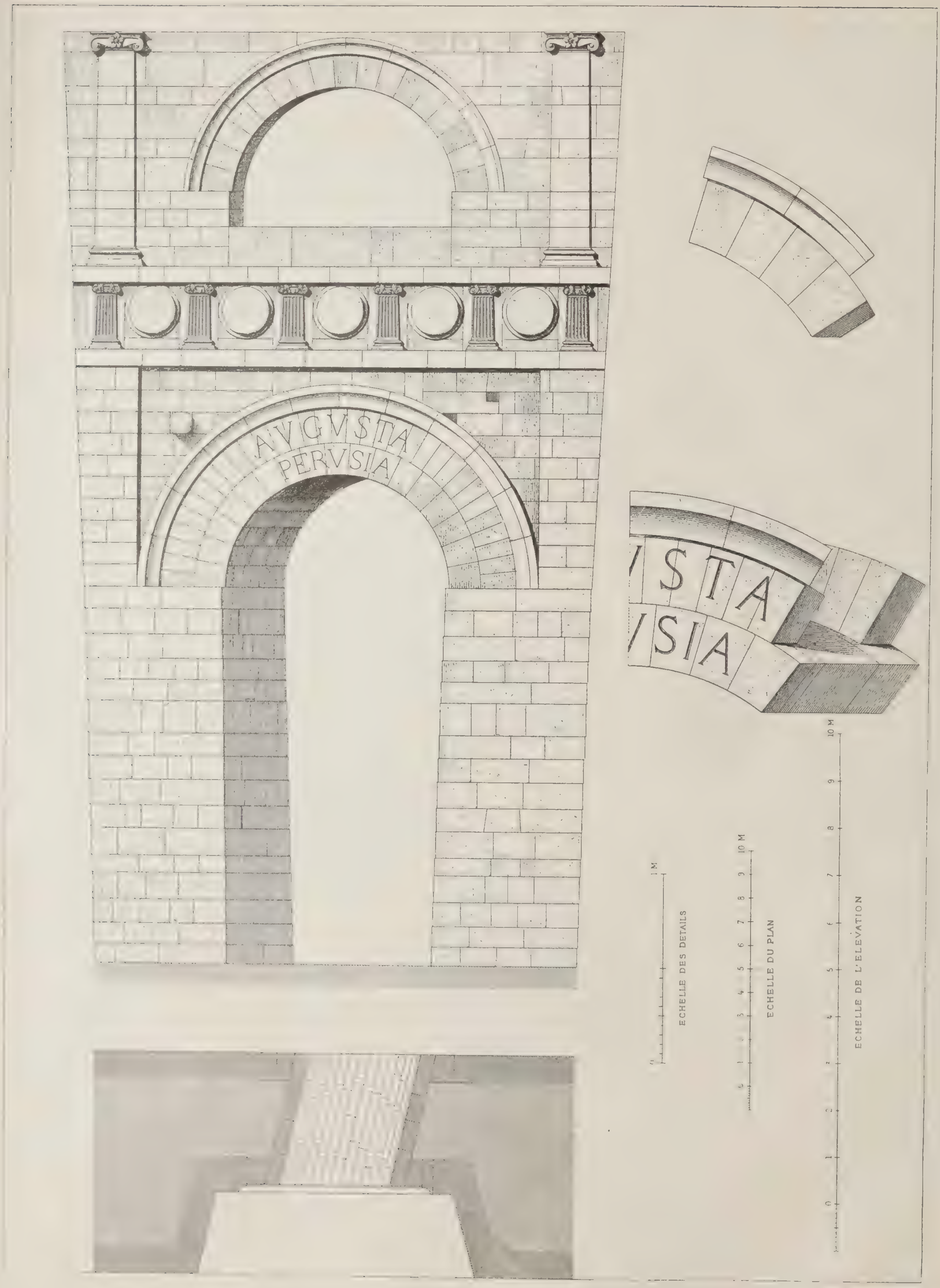
Cod. Theod., Lib. VI., tit. XXIII., 3, 4; tit. XXVI., 14; tit. XXXIV., 1, 4; Lib. XI., tit. XVI., 5, 15, 16, 18, 19, 20, 21, 22, 23; Lib. XIII., tit. III., 12; Lib. XIV., tit. IV., 6; Cod. Just., Lib. X., tit. XLVII.

[6] Lact., de Mortib. persec., Cap. VII.

[7] Aurel. Vict., de Cæsarib., Cap. IX.. I take this observation from the work of M. Naudet, "des Changements opérés dans toutes les parties de l'Empire romain," etc.



VIVIERES.
PLATE XIX. THE ART OF BUILDING AMONG THE ROMANS.



PEROUSE.
PLATE XX. THE ART OF BUILDING AMONG THE ROMANS.

under the obligation of contributing to the expenses of the great cities.[1] But finally, incapable of meeting the exigencies of the imperial tyranny, the inhabitants of the country, as, for example, in Gaul, profited by the relaxation of the bonds which tied them to the empire to arm themselves against it and ceased to be its auxiliaries in order to become its enemies.

In their turn the corporations had their period of decline; their members, ruined by a system of tariffs and statutes that legally de prived them of part of the payment due for their services, came finally to seek asylum outside of the cities by taking refuge in the colonies, or even going beyond the frontiers; they sought to find a larger and more liberal life among the barbarians. This was the signal for the abandonment of the old methods; they had declined with the increase of public misery, but they fell definitely with the fall of the corporations that were the depositories of their secrets. The first constitutions opposed to the dissolution of the corporations date from the immediate successors of Constantine. They attempted to stop the evil by reviving the traditional methods; but the fall was irremediable, the sequence of the traditions was broken, and architecture existed only in the memory of the past and in the monuments of the Roman greatness.

It is hardly necessary to point out the differences which should distinguish the methods of the architecture of the empire and that which is suitable to modern nations. They lie in the differences of the two civilizations themselves, and they arise from the double picture we have shown of the methods of building, and the institutions that explain them. Knowing how the methods of the art of building of former days satisfied the needs of the Roman civilization, one can easily see the reasons that should prohibit them to-day, or at least modify their form and limit their use; it can be understood that these gigantic constructions, where the simplicity of the methods is compensated by an immense increase of labor, properly belong to the days of slavery and forced labor. The affranchisement of the laboring classes, putting a price on all work, imposes on the builder the necessity of taking the material difficulties more into account, of measuring with greater care the amount of time and effort he must spend. The Roman methods are possible only under a great empire whose resources are concentrated under an absolute government; and this is so certain that the Romans themselves, as soon as they built for private purposes, as soon as they had to pay for labor, either in salaries to the members of the corporations, or in buying the slaves who worked for them, renounced the luxury of solidity. The vestiges of Pompeii, and the ruins of the villas scattered about the Campagna of Rome show this fundamental distinction most clearly; their construction is essentially slight, and they are less like the official works of the contemporary epochs than like the buildings of the Lower Empire, whose construction is recalled by the Christian basilicas. Moreover, the work to be expected from slaves is different than that from free workmen exercising without constraint their chosen trades. Intelligence develops with the amelioration of physical conditions, and we may ask more from logical combinations and less from physical force; in a word, we may leave a greater field for the personal initiative of each artisan. This is one of the first causes of the changes in the art of building, but still other reasons oblige us to give our architecture a new aspect, and apply different methods to our construction.

There are, in fact, two methods of construction appropriate to two clearly distinct conditions of society; either buildings are constructed as a whole of a solidity that protects them from the chances of destruction for centuries, or else, accepting the conditions of maintenance, and the chances of a proximate reconstruction, buildings are erected whose existence must be prolonged from day to day, whose preservation is a constant expense. It is the last method that tends to prevail among modern nations. Given up to the preoccupation of production, they seek to reserve for creative enterprises a part of the resources which the Romans devoted to the monuments of the empire; and when the income of the amount so saved exceeds the cost of maintenance and reconstruction, the difference is regarded as an increase of the public wealth. The Romans would have difficulty in comprehending such a calculation. Accustomed to live by the labor and tribute of conquered nations, they regarded their personal interests as the end and aim of all the energy of the peoples whom conquest had made their slaves, and they found in this resource all that was necessary to give their works a solidity which it would be wrong to seek in modern times. Our buildings will have but a short existence; many of them will scarcely survive us. It is not sure that the needs to which they owe their existence will last after us; and the ruin of these frail edifices is a small matter if the economy in building them as they are built is sufficient to replace them by others more in accord with the new generations.

Unceasing transformation; this, in a word, is the condition of modern architecture. The constant movement of society forces architecture into a series of changes whose result it is useless to predict and whose end is impossible to foresee. But whatever make be its variations, our architecture is bound to the past with unbreakable bonds; its origin carries us back, in spite of ourselves, to ancient Rome, and for a yet long time will it be necessary to seek the principles of its methods and the hidden end to which it is tending.

THE END.

[1] Cod. Theod., Lib. XV., l. 18 et 26: Laws cited by M. Serrigny in his work on "Le Droit publique et Administratif des Romains."

ENAMELED BRICKS FOR THE FRONTS OF BUILDINGS.

AT the time that the American "glazed" bricks failed, English enameled bricks were imported at a much higher price, and were used for facing the interior courts of most of our large office buildings. One of the most recent, however, the Marquette, has been faced in its courts with the new-made American enameled bricks. Thus far these inner courts have afforded the principal places for their use; but in England they are extensively employed on the interior of buildings, in the lining of kitchens, vestibules, and latrines, and for manufacturing buildings and laboratories, in which they effectually resist the action of the acids in the air.

In cities of the interior of this country, where much bituminous coal is consumed, the *bête noire* (almost literally) of the architect is the disfigurement of the exterior of buildings with the condensations from soot. These are of a gummy nature, contain creosote, adhere with obstinacy to every building material, and after a few years they cannot be removed, even with soap. Red bricks were found to turn to a dirty chocolate color, and were not free from disfigurement. The only remedy that house owners could find (and that an expensive one) was to paint stone and brick alike, so that to-day more than half of the best buildings of Chicago and other cities are painted.

The architects of the Rookery saw their opportunity to avoid this in one fine building when the dark semi-glazed "obsidian" brick came on the market. This was a frank acceptance of the situation and a surrender to what was then thought to be the inevitable. They made the exterior the exact color of smoke-dirt, and so it has remained ever since; but we now see the dirt and not the bricks, which are completely covered. The owners have avoided the expense of repeated painting, and have been the gainers thereby. Many other buildings have been similarly faced since then.

But since reliable American enameled bricks have been on the market, architects and owners have been able to face their buildings with bricks that can be kept clean if washed periodically; for even the best enameled bricks will not keep themselves clean, and the hardest rains will not wash off soot condensations. But washing is cheaper than painting. — *Inland Architect.*

THE falling of a piece of cornice, from the eleventh story of the Times Building on Park Row, New York, illustrates the danger of using stone for projecting construction in cities. Sandstone was employed in this case, and the Building Department stated that frost was the active agent in causing the accident.—*Eng. News.*

Fire-proofing Department.

TEST OF FIRE-PROOFING MATERIAL.

WHEN one considers the immense interests involved and the terrible consequences of the failure of any vital portion of a large building, the reasons for frequent and thorough testing of all kinds of building material is readily appreciated. Even with the utmost care unexpected weaknesses may be developed. While such conditions might not be entirely obviated by proper tests, it is quite certain that preliminary investigations would be apt to reveal indications of possible failure, and a wise constructor would give a questionable material the benefit of the doubt by avoiding its use altogether. Tests are quite as desirable for ascertaining what to avoid as for affording a measure of possibilities, and our constructive literature is full of reports of both public and private tests of all sorts of materials. It is, however, with the more recently adopted materials of construction that tests have been most numerous, and especially with fire-proofing in its various forms, a construction which has struggled out of an experimental stage, and from which, as has been admirably shown by Mr. Wight's articles in these columns, very definite, and on the whole extremely satisfactory conclusions have been reached, and there have been in recent years many exhaustive and satisfactory tests made with a view to determining the reliability of the various fire-proofing mediums. Any one who has compared reports of the various tests cannot, however, but be struck with one fact which is very prominent, namely, that the large majority of them have been devoted to an investigation of the material itself, independently of the method of use; thus there have been experiments in Denver, New York, Boston, in fact in nearly every large city, which have shown conclusively that terra-cotta can be depended upon to resist a high degree of heat, and to properly protect a concealed steel construction. The results of most of these investigations are permanently on record, and are readily available to the student or the constructor, and the tests have been so thorough and impartial that it would seem as if, after the years which were taken to develop the fire-proofing industries and the numerous opportunities for showing the resisting powers, we ought to be pretty well down to a basis from which we can start in laying out any species of construction depending for its protection upon the qualities of burnt clay. We believe in tests. They not only keep alive an interest in scientific reasoning, but they serve to keep up the standard of the manufacturer, and yet we have been sometimes led to question whether the more recent tests of fire-proof buildings have not been in the nature of thrashing old wheat, whether the time has not come to stop questioning whether terra-cotta will stand fire or whether something else is better, and to confine our tests to a more practical demonstration of how to do rather than what to do with, admitting at the very start the results of investigations which are too manifestly decisive to admit of a great deal of argument.

Theoretically and practically it has been established that terra-cotta, if properly applied, does protect. The theoretical demonstration has been made in numerous private and semi-public tests of small sections of flooring, column protection, etc. The practical tests have been applied in such conflagrations as the Pittsburgh fire, Western Telegraph Building in New York, the Athletic Club in Chicago. Though opinions may differ as to the economic advisability of using one material or another, or a different form, terra-cotta itself is no longer an experiment, it is a scientific fact, the records of which are open to any one who reads.

But what we do need tests upon is the details of construction. No one is ready yet to admit that the last word has been uttered or the final solution achieved in the application of burnt clay to purposes of fire-proofing. There is a great deal of clumsiness in manipulation which must be obviated. There is weight to be reduced, there are shapes to be improved, and there are systems of application which would bear a great deal of study. Along these lines tests are of value, and a great many of them can be made to follow new and unsolved paths. The material itself, however, with all the variations of the different manufacturers in the different parts of the country, is practically the same throughout. It is not like steel, every melt of which may be different, and which, consequently, requires tests at frequent intervals. The extremes of hard and porous terra-cotta are perfectly understood, and can be scientifically analyzed and applied.

An absolutely fire-proof building is, of course, an impossibility, for no structure has yet been devised which could not be affected to some extent by heat if the combination of conditions were favorable. We cannot fire-proof the contents of any structure by merely enclosing the supports in a fire-resisting envelope. But we can vastly improve not only the details of construction, the methods of applying the brick and terra-cotta, the manner in which the protecting envelope is applied to the beams and the columns, the precise arrangement of supports, ties, etc., but we can also, to advantage, make very decided and radical changes in the arrangement of so-called fire-proof buildings, by which their resisting powers can be greatly increased. Fire-proof construction is not merely a question of floor and column protection, but one of the essential requirements is that the structure shall be so arranged that fire cannot readily spread from one part to another; consequently we need to devote more study than is usually allowed to the arrangement of corridors and partitions, as well as to the window openings and the construction of elevator wells and light shafts. It may be open to argument whether an elevator well is safer from a fire standpoint if it is enclosed in brick walls than if it is entirely open. In the former case it can easily become a huge blast chimney. In the latter case the fire enters it more readily. But certainly the partitions and elevator arrangements are not usually conspicuous for the amount of study which has been expended upon them, and we could well afford to expend some of our test money upon the determination of the best kind of construction to answer for partitions, to resist not only heat, but also the air pressure, which sometimes is quite considerable in a building, as well as the even more disastrous effects of the fireman's hose. One of our correspondents has said quite truly that in one of the notable instances in which a fire-proof building was exposed to the effect of a conflagration from an adjoining structure far more damage was done by the firemen than by the fire; that if the building had been left alone the waves of fire would have beat against it impotently, but the combination of water and fire was too much for it. All of which simply shows that we must consider all possibilities in designing a fire-proof construction.

Then there is opportunity for considerable investigation in devising a fire-proof window. It has been suggested that wire glass could be used in metal frames, and that wire glass when properly set will melt before it will let the heat through. So far as we know, this has never been tried, and we should suppose that, even assuming the glass stood the heat, a few drops of water might change conditions considerably. Window frames and staff beads are almost invariably built of wood. In the fire in the Potter Building, New York, some time ago, if we are correctly informed, fire was communicated from story to story through an interior well by means of the wood finish around the windows. If instead of exposed wood the frames were to be set flush with the jambs or with a projecting terra-cotta molding to cover the frame, and the sashes themselves were of sheet metal on a wood foundation, similar to the construction of tinned wooden shutters, the danger of ignition would be reduced to an insignificant minimum. Here again is another chance for a long series of valuable fire-proofing tests. In fact, the possibilities of improvement in even the best of our fire-proof structures are so manifest, there is so much remaining to be done which can be accomplished only through the direct agency of carefully conducted scientific experiments and tests, that we can well afford to admit the results of previous investigations, and can with great profit continue our investigations along the line of the unknown, having already so much firm ground to tread on.

A COMPETITIVE (?) TEST.

New York, Dec. 20, 1897.

To the Editor The Brickbuilder: —

Dear Sir: — The impression seeming to prevail among those not familiar with the details, that we were participants in an attempted joint test of our end-construction, porous hollow-tile arch, and one of the Roebling concrete method, which occurred on November 19, last, at 68th Street and Avenue A, this city, we ask that you kindly grant us the use of your columns for a dispassionate statement regarding it, from its inception to its final merited miscarriage.

We do not dispute the fact that portions of the tile used in the construction of this arch were procured by John A. Roebling's Sons Company in a near-by city, but aside from that we had no voice in the matter of detail or the manner of construction.

Under the administration of Stevenson Constable, Superintendent of Buildings, New York City, and the supervision of his brother, Howard, there have been no less than fourteen tests made of different systems of fire-proofing, all governed by the following conditions: — 5 to 6 hours' firing, followed by water applied under a pressure of 60 lbs. to the square inch. A full report of these various tests was furnished *The Engineering Record* (see Vol. 36, Nos. 16–19) by Stevenson Constable.

Deeming the fire period — 5 to 6 hours — which had governed these fourteen tests inadequate to determine the resistance to intense heat of fire-proofing material, we, in March last, at the request of Mr. Constable, threw down a challenge to all, for a joint test of *24 hours' continuous fire*, of 10 in. porous end-construction flat arches, followed by water applied under a pressure of 60 lbs. to the square inch. On September 7, the John A. Roebling's Sons Company, in a letter addressed to Constable, purport to accept our challenge; but instead of a fire test of 24 hours' continuous duration — the main purpose of our challenge — propose one of 4 hours only, which is to be followed by cooling, then application of water, and so repeated; and further providing: "The Roebling arch to be constructed in the same manner — material, quality, and proportion — as they will guarantee to construct their floor systems *in the future* in the city of New York." "The material for the hollow brick arch to be purchased at some building in course of construction, where such material has been delivered by Henry Maurer & Son, without special selection as to quality, and to be the regular 8 in. hard-burnt clay or porous terra-cotta side or end construction."

These conditions not confirming to those of our challenge, we declined the proposition and considered the whole matter settled; at which conclusion it seems the Roebling Company also arrived.

The John A. Roebling's Sons Company, however, instigated by Mr. Constable, determined to proceed with the test — under conditions imposed by themselves, and presumably the most favorable for their method — and with the material procured at considerable trouble and expense, with additional tile from other manufacturers, they proceed to erect an end-construction arch of 5 ft. span, in a structure adjoining a concrete arch prepared, superintended, and constructed by them.

We quote: "The Roebling arch in the test structure was identical as to proportions, manipulation, etc., with the fire-proof arches erected by the John A. Roebling's Sons Company, and represents the standard construction of that company.

"The hollow-tile arch is a modern pattern, end-construction type, of flat arch erected with care" (sic) "so as to represent as nearly as possible the usual workmanship, as found in fire-proof buildings now in the course of construction in New York City."

It did not require deep penetration to discern the result — sure to follow — when a hollow-tile arch, constructed, as we see, under the fostering (?) care of a rival concrete interest, came to be tested, and that test under the sole control of such interest; the result we had foreseen followed. The end-construction arch, after 3 hours' firing, loaded with but 150 lbs. to the square foot, fell in; but in falling disclosed the secret of its fall: glaring defects of construction!

A study of the results of other tests, both of hollow-tile and the Roebling concrete arch, which we collate below, will convincingly show that the test, of which this letter treats, was simply a farce.

TESTS OF HOLLOW-TILE ARCHES.

Denver, Col., Dec. 20, 1893.

"An end-construction, porous terra-cotta arch of 5 ft. span, after undergoing a continuous fire test for 24 hours, was practically uninjured, as it afterward supported a weight of bricks of 12,500 lbs. in a space 3 ft. wide in the middle of the arch."

Pittsburg, Pa., May 3, 1897.

"The report of S. Albert Reed to the New York Tariff Association shows that the end construction, porous tile arches were superior to the side-construction, hard-burned tile arches; that all floors of either method were practically uninjured."

But our concrete friends claim that these tests were too far from New York to be conclusive, so we quote Stevenson Constable himself: —

New York, Sept. 29, 1896.

(See *Engineering Record*, No. 19, pp. 402, 403.)

"An end-construction, porous terra-cotta arch, loaded with 150 lbs. per square foot, was subjected to a fire test of 6 hours' duration, uninjured. Nearly 20 days thereafter the load was increased to 1,960 lbs. per square foot, and the arch still declining to fall, the test was discontinued.

Maximum deflection . . . . 3.41 ins."

May 20, 1897, *Engineering Record*, No. 19, p. 405: —

"A side-construction, hard-burned tile arch loaded with 150 lbs. to the square foot was tested under 5 hours' firing, uninjured. On May 22, 1897, load was increased to 600 lbs. per square foot without injury.

Maximum deflection . . . . 1.84 ins.
Maximum temperature . . 2,050 degs."

Our concrete friends now claim: that an end-construction arch, of our material, but built under their direction, loaded with but 150 lbs. to the square foot, after firing for less than 3 hours, fell in.

Maximum temperature, 2,300 degs.

Maximum deflection, 3.65 ins.

It is an undisputed fact that in the preparation of hollow tile, the raw material (clay, etc.) is subjected in burning to a heat of fully 2,800 degs., sustained for from *6 to 7 days*.

TESTS OF ROEBLING CONCRETE ARCHES.

From report of Stevenson Constable, New York, Sept. 25, 1896, *Engineering Record*, No. 359.

"A Roebling concrete arch, which we are justified in presuming 'represented the standard construction of that Company,' loaded with 150 lbs. per square foot, was subjected to firing for 5 hours. Upon reopening doors before putting water on it was seen that all the plaster and wire netting had burned off except in the extreme corners.

Maximum temperature . . 2,300 degs.
Maximum deflection . . . . 4.485 ins.

Mr. Constable being restrained from interference, we can only quote from report in *Engineering Record*, p. 556, — source unknown to us: —

"The Roebling arch remains intact, with shreds of the skin coat hanging to the ceiling, the brown coat remaining intact.

"2,300 degs. maximum temperature.

"1.4 in. maximum deflection."

Yours truly,

HENRY MAURER & SON.

New York City, Dec. 20, 1897.

Mortar and Concrete.

CHARACTERISTICS OF VARIOUS BRANDS OF AMERICAN NATURAL CEMENTS.

BY CLIFFORD RICHARDSON.

COMPARED with the typical high-grade lime and magnesian cements, which have been described, very considerable variations are found in numerous other brands of the East and West.

Rosendale Brands. The many brands of Rosendale cement from Ulster County, which are on the market, while in general, very similar and of excellent quality, still show very decided differences in certain directions. Some give much stronger mortars, both in initial and eventual strength, than others, and display very considerable variations in their time of setting and density. They show corresponding physical and chemical differences. This is due to the variations in the rock from which they are made. It has been shown to differ in composition in the two principal strata found in Ulster County, and again in different exposures of the same stratum. Along the several miles of outcropping where Rosendale cement is made, extending from Rondout to High Falls, very varied rock is found. In most cases where a deficiency exists, it is in the amount of clay in the limestone. It carries too little, and the cement made from it is hot and lacking in strength. An examination of the analyses of five samples of Rosendale cement, given in a previous table, shows that from 8.68 per cent. of oxides of iron and alumina to 15.20 per cent. is found. This alone would produce a marked difference in the several cements. Further, the magnesia is as high as 19 and as low as 14 per cent., the silica reaches 24 and falls as low as 11. It is easy to see, therefore, that different brands of Rosendale cement, or the same brand at different times, may vary, although the material as a whole is of one general character, and that individual brands can only be expected to be uniform when the greatest care is exercised. The best cement plainly contains, within limits, of course, the most silicates and the least magnesia. It will then be the least fiery and give the greatest returns in the strength for the mortar prepared with it.

Depending upon its origin, Rosendale cement may vary so that tests of sand mortar, 2 to 1, may fall as low as 30 lbs. at the age of seven days and reach 100 lbs. The cement may set slowly or too quickly. It will, eventually, in almost every case, yield results which are satisfactory in so far as that the mortar is dense and not brittle and continues to gain in strength with age, not deterioriating after long periods of time. Mortar of Rosendale cement is particularly desirable for laying up masonry, as it is plastic and trowels well. In concrete it is satisfactory only in the best brands or where a considerable time can elapse awaiting the acquisition of strength. Where centers are to be drawn rapid work cannot be done with Rosendale cements, so that when the Potomac Valley cements are available but little Rosendale is used, while in such work as fortifications and gun emplacements, where slowness of setting is no objection, it is a most desirable material.

Rosendale cement mortar will not withstand frost as well as the lime cements, but is superior in this respect to that made with many other magnesian cements. The greater the amount of magnesia in a cement the less it is able to resist cold weather. Rosendale cement suffers more in strength at an early period from the use of an excessive amount of water in mortar than lime cements and some magnesian brands, but eventually recovers quite or nearly the same strength as when less water is used. A test of a Rosendale cement, initiated in 1892, illustrates this in the following figures: —

2 parts quartz, 1 part cement.	Tensile strength per sq. in. Dry Mortar.	Moist Mortar.
7 days	38	20
28 "	68	48
3 months	200	140
6 "	220	198
1 year	246	236
2 years	242	232

It appears that the deficiency in strength of the moist mortar at the age of three months has disappeared when it is one and two years old.

Western New York Cements. The cements made at Buffalo and Akron, in Erie County, New York, are magnesian like the Rosendales, but they differ from the Ulster County cement very decidedly. They often have a greater initial strength, both in neat and sand mortars, but after the lapse of time fail to show the same increase and at times fall below some other cements at the age of a year. To what this is due may be seen on examining their composition. They contain a very much larger amount of magnesia, nearly 26 per cent. as compared to 14 in the best Rosendale, and the amount of alumina and iron oxide is reduced to between 7 and 10 per cent., as compared with 11 to 15. The peculiar differences between the Erie and Ulster County cements is plainly due to this difference in composition, and more especially to the larger amount of magnesia. This has been known to eventually cause some brands of this cement to expand sufficiently to reduce its strength, and in some cases to show a deficiency in strength without apparent expansion. The amount of expansion which takes place with these cements may be seen in the concrete base of asphalt pavements in some cities, which at times are raised into waves several inches high, crossing the streets at intervals. These ridges are so marked that from time to time they must be cut out and the surfaces lowered.

Where the amount of concrete is not extensive, and expansion insufficient to produce heaving, the cements have, in most cases, given sufficiently satisfactory results. Their greater strength, when first used, gives them a certain advantage over other slower cements, but they are plainly not entirely well balanced in composition. The presence of so much magnesia necessitates great care in burning, and considerable variations will be found in the product, depending on the extent to which calcination is carried, and the way in which it is done. Hydration of the burned stone before grinding has, however, improved these cements in recent years. They are in color a very light buff, and are not nearly as dense as the Rosendales. They require less water for working than any other cements, and are very plastic. Their use has extended over a large field of engineering work.

Potomac Magnesian Cements. Several cements are made in the Potomac Valley, not far from where the Round Top lime cement, already spoken of, is burned, which are magnesian in character. They are of local importance only, but are interesting from a technical point of view in comparison with others of the same class. They contain about the same amount of magnesia as the Rosendale cements, and in their best form, nearly as much alumina and iron oxide, but often are deficient in this respect. They are not burned as hard, and so show a greater loss of carbonic acid on ignition. They are distinguished by their color, which is a pale-yellowish buff, from the dark colored cements of Ulster County. They resemble, in the practical results obtained with them, the best forms of Rosendale, and often excel them, troweling well and acquiring strength slowly. In concrete they harden to an extremely tough mass, and with the exception of having a very slow set in cold weather, like all magnesian cements, and acquiring little strength soon after use, are equal to any of the natural cements, especially in their final results. They vary considerably, and should always be carefully tested and watched, but are quite as reliable, as a whole, as any of our magnesian cements. The writer has never seen more satisfactory concrete than has been made with these cements, both in the arches of concrete sewers and in the base of pavements in Washington, D. C.

(*Continued.*)

SAND CEMENT.

Editor Brickbuilder: —

Dear Sir: — The advent of a new building material will always be received with curiosity and criticism. At first, no doubt, the former will prevail, but soon the latter will assert itself.

It is probable that this is the present state of affairs regarding the use of Silica Portland, or more commonly called "sand cement."

Its use in Europe, especially in Denmark, is an assured fact, and, I believe, success.

In the United States I understand that progress is satisfactory, but probably retarded by the abundance of a high class of Rosendale and other natural cements, as well as high-grade Portlands.

In Canada, the Rathbun Company, of Deseronto, have control of the output of this product for the whole Dominion, and have tube mills producing it not only at their works at Napanee Mills, but have established also a branch in Montreal. I believe they are crowded with orders for months ahead, and certainly, if the enclosed tests are fair indications of the average quality, it is not to be wondered at.

It would appear that the distinctive quality of *high early strength* so prominent in Portland cements is still present, and if this strength maintains itself indefinitely, which there does not seem any reason to doubt, then there is a distinct advantage gained.

Whether "sand cements" of a sliding scale of proportions of sand and cement ground together will be able to meet the various requirements of trade the future alone can decide, but much will depend on the frankness and honesty of the makers. The brand labels of this product should, I believe, state plainly what proportions of the two materials are in each package, or else large avenues of fraud will be open of which the manufacturers are innocent.

TESTS ON "SAND CEMENT."

MADE IN THE MCGILL UNIVERSITY CEMENT LABORATORY.

(*a*) "*Citadel*" *Brand* (1 cement to 1 sand).
Residues on No. 100 Sieve, $\frac{2}{10}$ of 1%.
on No. 180 Sieve, ½ of 1%.
Neat tensile strength, 1 week, 332 lbs. per square inch.
4 weeks, 475 „ „ „
Neat compressive strength, 4 weeks, 3,837 lbs. per square inch.
1 Sand Cement
3 Standard Sand } Tensile strength, 1 week, 135 lbs. per square inch.
4 weeks, 141 „ „ „
2 months, 135 „ „ „
1 Sand Cement
3 Standard Sand } Compressive strength, 1 week, 470 lbs. per sq. in.
4 weeks, 687 „ „

(*b*) "Ensign" brand (1 cement to 1 sand).
Residues on No. 100 Sieve, $\frac{6}{100}$ of 1%.
No. 120 Sieve, $\frac{1}{10}$ of 1%.
Neat tensile strength, 4 months, 810 lbs. per square inch.
6 „ 780 „ „ „
1 Sand Cement
3 Standard Sand } Tensile strength, 1 week, 189 lbs. per square inch.
2 weeks, 201 „ „ „
1 Sand Cement
3 Standard Sand } Compressive strength, 1 week, 900 lbs. per sq. in.

(*c*) "Jubilee" Brand (1 cement to 6 sand).
Residues on No. 100 Sieve, $\frac{3}{100}$ of 1%.
No. 120 Sieve, $\frac{13}{100}$ of 1%.
Neat tensile strength, 4 months, 340 lbs. per square inch.
6 „ 540 „ „ „
1 Sand Cement
1 Standard Sand } Tensile strength, 1 week, 300 lbs. per square inch.
2 weeks, 379 „ „ „
1 Sand Cement
1 Standard Sand } Compressive, 1 week, 2,800 „ „ „
1 Sand Cement
2 Standard Sand } Tensile strength, 1 week, 184 „ „ „
2 weeks, 215 „ „ „
Compressive strength, 1 week, 1,225 lbs. per sq. in.

CECIL B. SMITH.

Montreal, Can., Dec. 6, 1897.

The Masons' Department.

THE LICENSING OF CRAFTSMEN.

NOT the least of the beneficial improvements which we owe to organized labor and the trades unions is that which has resulted in the licensing of some of the specialized mechanical occupations. In most of our cities a plumber, a gas fitter, or a steam fitter has to obtain a license from the authorities to follow his trade, and we believe it is generally felt that such municipal regulation is a wise one. Agitations have been made from time to time looking towards the further extension of the licensing system. We are heartily in favor of requiring all master mechanics to pass some sort of examination before being allowed to practise a trade. The interests are too vital and the welfare of the public might be too seriously threatened by neglect or bad workmanship to warrant a disregard of possibilities of control, and we have recently had instances in several of our cities of the results of entrusting building operations to uneducated mechanics. Illinois is the only State so far who has gone even further and has required the architects to be licensed. When such a measure is proposed there is immediately a cry raised of close corporation and a desire to squeeze out the humbler members of the profession who have not had opportunities; but looked at aright, it is not at all a question of the individual, but rather of the community, and there is every reason why an architect should be required to thoroughly understand his business in a constructive sense before he can place himself before the public in a professional capacity. The time has long gone by when mere rules of thumb are sufficient in architecture. In the good old colonial days they built by guesswork. The fact that many of the colonial structures are standing in excellent condition today is due to the very large factor of safety, possibly more correctly termed a factor of ignorance, which sometimes entered into the work; but if any one thinks mere judgment or experience without a substantial backing of positive scientific knowledge is sufficient to erect a modern commercial structure, he will be sadly disappointed with his first practical experience. Architecture is preeminently one of the educated professions, and wholly aside from any question of artistic license, which, to be sure, is quite as desirable as constructive restriction, though more intangible and less readily formulated, the architect cannot be trusted to depend upon the good-wlil of mechanics who might calculate his strains for him and provide against the possibilities of his own ignorance. Architecture ought to be a close profession, entrance to it being closely guarded by legal restrictions which would insure to the community that the man who has a license knows at least the constructive details of his business.

But licensing the architects, obliging them to know their business, does not relieve the builder from a responsibility. It can truly be said that all the architects in Christendom cannot make a good builder out of a poor one, and that if he does not know his business no architect can teach it to him. The two callings are correlated and interdependent, while at the same time there are distinctive features of each that must be mastered. And besides, the fact is that most buildings are not put up under the supervision of an architect. We will go even further, and venture the statement that a large majority of the poorly constructed buildings are put up without any intelligent forethought from either architect or builder. An owner wishes to economize, and not only dispenses with architectural services, but takes the lowest bidder who will assure him that he knows how to do it. Of course we blame the owner for such shortsightedness, which, however, is more often due to ignorance than to the intent to build poorly; and right there is where the city has a perfect right to step in and insist that the builder shall know his business, shall be competent to decide on all general points of construction, and that before he can be called in to put up even the humblest structure he must receive approval and a license from the community. We hope the work of municipal regulation may go on and extend, for if properly regulated it cannot but be of value to the

community, besides elevating and improving the condition of the mechanic and the architect.

HIGHER TECHNICAL EDUCATION.

THE subject of licensing of craftsmen is naturally associated with provision for a higher technical education in the mechanic arts. As we survey the situation, the organization of our building trades, as relates to the craftsmen themselves, is on the whole not as favorable for individual development as it was a few generations ago, when the apprentice system, with all its defects and limitations, did manage to turn out a very fair quality of workman, who at least understood his tools, and had had experience under the eye of a master who knew more than he did. The apprentice system to-day is a theory rather than a fact in most of our cities. For it the best substitute is afforded by the mechanic schools, which, in their possibilities, are undoubtedly far superior to any apprentice system, but which need to be largely broadened in their scope, and brought more closely in harmony with actual handicraft to be of the immediate value which those who are interested in them believe they should be. A good bricklayer need not possess a knowledge of integral calculus. We question even if he need a very special knowledge of even the lower forms of mathematics. But an intelligent appreciation of the material which he uses, the way in which it acts, and why it is used as it is, is quite as essential as a mere manual dexterity in the use of a trowel and cold chisel. There are some ideas which die hard with the average mechanic, such as the theory, for instance, that putting lime in cement mortar in cold weather improves the quality of the mixture and keeps it from freezing. If our manual trained bricklayer were properly instructed he would know better, and would, we venture to say, feel a keener interest in building his wall properly and using mortar in a logical as well as scientific manner. Now every one, even in this enlightened age, cannot have a technical education, and yet every one in our free country aspires to a higher position than the one he is born to; and in proportion as the intelligence of the individual craftsman is raised, it goes almost without saying that the resulting work is going to be better because of the possibilities of growth which it puts within the reach of the mechanic himself. Intelligent work is always more economical, even if the price per hour is greater. In the Southwest the saying is that it takes two Indians to do the work of one Mexican, and two Mexicans to do the work of one Eastern laborer. It isn't because there is more muscle in one case than in the other, but it is because of the intelligence which directs the hand, so that the trained mechanic is cheaper at five dollars a day than an unthinking laborer at one dollar.

UNDERPINNING HEAVY BUILDINGS.

SOME one has aptly characterized the difference between medieval construction and the more recent methods as being typified by the use of the nail and the screw, our modern construction being put up so it can be taken apart, whereas the medieval work was put in place to stay. An even more striking development of modern work is in the line of adding to a building in its vital constructive features after it is all done and occupied, a feat which would presumably have been undreamed of in the building periods of the past; but with our rapid modern growth it is every year found more and more desirable to make radical changes in existing structures, and the partial reconstruction of buildings has developed into a very interesting and quite exact science, notably in as far as relates to the underpinning or extending downward of the foundations of a building. This is a department of building which is intensely fascinating to even the most unprofessional observer, and one appreciates the capabilities of modern science more fully by following in detail some of the devices which have been forced upon constructors in our attempts to obviate the existing weaknesses of foundations, or to provide suitable supports for increased loads. The time was when foundations were put in to stay, and the thought of sinking them deep and making them broad implied a permanence which would never be disturbed. But with our modern scientific agencies we can pick up a building, hoist it in the air, build under it to almost any extent, or move it bodily for a considerable distance, not only with perfect safety and surety of results, but with an ease of operation which is a constant source of surprise even to those who are intimately associated with this kind of work. The subject forms a distinct chapter in the development of our national constructive architecture, and merits so much more than a passing note that it is our intention at an early date to take it up in detail and illustrate the subject by a series of articles which shall show what has been done in notable instances. It has special relevancy to our own peculiar field, brick having been found peculiarly adapted for the underpinning of heavy buildings, inasmuch as limitations of space usually forbid the employment of a bulky material, and brick has naturally been adopted because it affords an opportunity for thorough construction even when applied under most disadvantageous conditions. A number of the heaviest buildings in the world rest upon brick foundations, which were put in place under conditions which would have been prohibitory for any other material.

STAINING BRICKS.

IT frequently happens that a builder has to build an addition to some brick building already up; and it also happens that he cannot procure bricks to match the old bricks in color. To get over this difficulty he is compelled to use bricks available and render them the color of the old bricks by staining, or staining the old bricks to correspond with the new. There are several methods — all good — of staining bricks, and for the benefit of those builders who may require to employ one or other of the methods we submit the following: To make a good durable red stain, mix Indian red, or Venetian red, with a solution of good Portland cement, regulating the color by adding a little Spanish brown if necessary. Mix with this fine sand, washed clean and dried, before being added to the solution. Cement and sand may be used in equal proportions. The mixture is to be a little thinner than ordinary paint. It must be stirred while being used, and applied with a brush. Another red stain, which is easily applied, looks better than the first, but lacks durability. Take as follows and in proportion to amount required: One ounce of glue melted in one gallon of water, add a piece of alum the size of an egg, then a half pound of Venetian red, and one pound of Spanish brown. Try the color and mix more light or dark to suit. For a buff or cream color, use any yellow mineral paint, such as yellow ochre, adding a mineral white to make it light if necessary. For black, use asphaltum heated to a fluid state before applying. Bricks should be stained black before being laid, and the best way is to make the brick moderately hot, then dip them about one inch in the melted asphaltum, and leave them to dry before being used. This makes a good, durable job, if they are held in the mixture for a moment or two in order that the color may have an opportunity of being absorbed to the depth of a sixteenth of an inch. Another method of staining bricks black is to mix together asphaltum and linseed oil, and heat the mixture until it will mix together well. Heat the bricks and dip them in the mixture, where they should remain for a short time. The best way to stain black is to have a flat pan over a fire; fill the pan until it has about an inch in depth of the mixture. Place in the pan as many bricks as it will hold, then take out the first brick and replace it with another. Put the stained brick on a board or a clean spot to dry; then take out the second brick and put another in its place; and continue this operation until brick enough are stained, minding to keep up the supply of asphalt and oil. — *Canadian Architect.*

RIGHTS OF PURCHASER OF EFFECTS OF INSOLVENT CONTRACTOR: Where one buys at sheriff's sale the property of a contractor who has failed, and assumes the place of the contractor, under a partially performed building contract, and completes the work for him, he is entitled only to the amount which would have been due the contractor who had been overpaid for the work already done by him.— *Superior Court of Pennsylvania.*

Recent Brick and Terra-Cotta Work in American Cities, and Manufacturers' Department.

NEW YORK. — As would naturally be expected, the month of November was quiet in regard to real estate and building transactions as compared with the many active months preceding, but the records show a healthy improvement over the corresponding month of '96. The most important event of the month was the decision of the competition for the New York Public Library and the award of the contract to Carrere & Hastings, architects; an award

TERRA-COTTA FIGURE, HARTFORD TIMES BUILDING, HARTFORD, CONN.
A. W. Scoville, Architect.
Executed by the Conkling, Armstrong Terra-Cotta Company.

received with great satisfaction by all; and from the illustrations published, we can predict that New York will become the possessor of a beautiful building of which we can be justly proud. The building will be erected on the site of the old reservoir at 42d Street and Fifth Avenue. Nearly $3,000,000 will be expended, and the time occupied in building will probably be at least three years. The competition for this building was the most important since the Episcopal Cathe-

HOUSE AT WASHINGTON, D. C.
A. S. Bell, New York, Architect.

dral, and we may safely say that no competition was ever more successfully or honorably conducted.

Soon after the decision of this competition the same architects were awarded the new building for the Academy of Design, another large and important work which will cost $400,000. The plans of Arthur A. Stoughton, architect, for the new Army and Navy Memorial Building in Central Park, have been accepted.

HAMILTON SCHOOLHOUSE, TRENTON, N. J.
W. A. Poland, Architect.
Front brick made by Oliphant & Pope Company.

TERRA-COTTA DETAIL, JEWELERS' EXCHANGE BUILDING, BOSTON.

Three five-story brick public school buildings, cost aggregating $750,000, are to be built at once. They will be located on 104th Street, near Second Avenue, 111th Street, near Lenox Avenue, and 104th Street, near Fifth Avenue. Frederick C. Zobel, architect, has prepared plans for a ten-story brick and stone fire-proof store and office building 75 by 100 ft., to be erected on 23d Street, near Lexington Avenue. Cost, $250,000.

Neville & Bagge, architects, have planned four five-story brick and stone flats and stores to be built on 112th Street, corner Fifth Avenue. Cost, $100,000.

BOSTON. — The two closing months of the year are seldom active ones in the building industry in the way of the giving out of new work for estimates. While these months of the present year have developed no extraordinary exceptions to this general rule, yet they have certainly shown a decided improvement over the corresponding months of 1895 and 1896; not only in Boston, but in New England generally. Considerable work projected last year and the year before, which was "pigeon-holed" pending improvement in general business conditions, has now gone ahead, and the plans for same given out for estimates or the contracts awarded.

TERRA-COTTA DETAIL, JEWELERS' EXCHANGE BUILDING, BOSTON.

One feature in connection with the stations of the Subway now open to the public is certainly open to criticism, and points to a moral distinctly favorable to the using of enameled brick or glazed terra-cotta as a covering for the iron columns or posts in public buildings in which a hurrying, crowded mass of people congregate. The posts which support the roofs of these stations are of iron encased in cement, square in form, and of about 20 ins. in diameter. When new, these posts were painted with some preparation which gave them a white, smooth surface, which did not last long, however, when they were exposed to the wear and friction of the passengers coming in contact with them. At the present time, although the stations have been in use but little over three months, these posts present a soiled, dingy aspect, but little in harmony with the glistening white of the enameled brick walls. Had the posts been encased with enameled or glazed tile they would have preserved a clean, attractive appearance, indefinitely. We are confident that the comparatively small increase in the cost of thus encasing these columns in tile, instead of cement, would be more than offset by the permanent character of the finish, which would require no attention

JEWELERS' EXCHANGE BUILDING, BOSTON.
Winslow & Wetherell, Architects.
The exterior is built entirely of cream-colored terra-cotta, executed by the Perth Amboy Terra-Cotta Company, and furnished through their New England agents, Waldo Bros., Boston.

and care beyond, perhaps, an occasional washing in soap and water; whereas, with the cement surface, there must be frequent repainting, at some expense, and at inconvenience to the traveling public.

It is to be hoped that in the stations now under process of construction in the sections of the Subway not yet completed, that the columns will be treated in the way suggested. This has been done most successfully in the Subway Station of the Illinois Central Railroad, Chicago, where all the columns supporting the roof are enclosed in glazed terra-cotta tiling.

Work on the New South Terminal Station continues to advance rapidly, and it is estimated by the engineers that about one third of the entire undertaking has been completed, showing that progress on the same has been fully up to contract time. The walls of that portion of the station technically known as the head house are now up to the second story, leaving three stories yet to be built according to the present plans. It is expected that the work of setting up the frame for the train shed will begin during January.

TERRA-COTTA DETAIL, JEWELER'S EXCHANGE BUILDING, BOSTON.

Among the new buildings now under process of construction or soon to be erected may be mentioned a $75,000 apartment house at Brookline; J. F. & G. H. Smith, architects; to be built of gray brick. Two residences for Francis Morton on Sutherland Road; Cabot, Everett & Mead, architects; to be constructed of brick. A mercantile building for John T. Morse, Jr., on the corner of India Street and Atlantic Avenue; W. T. Sears, architect. A brewery for the Star Brewing Company, at Roxbury, Otto C. Wolfe & Son, architects, Philadelphia; to be constructed of brick. A $50,000 business block in Malden; Tristram Griffin, architect; to be constructed of brick. A $40,000 schoolhouse at Watertown, plans for same being open to competition for architects residing in Watertown; to be constructed of brick. An insane asylum, to cost $150,000, at Cranston, R. I.; E. T. Banning, architect, Providence; to be constructed of brick and stone. New Court House at Chelsea, to cost $50,000; Wilson & Weber, architects, Boston; to be constructed of brick. New chapel at Providence, R. I., to cost $100,000; Martin & Hall, architects, Providence; to be constructed of brick and stone. Church at Hartford for the Pearl Street Congregational Society, to cost $100,000; Flagg & Bartlett, New York City, architects; to be constructed of brick and stone. A physical laboratory for Dartmouth College, Hanover, N. H., to cost $50,000; Lamb & Rich, architects, New York City; to be constructed of brick. A new jail at Fall River for Bristol County; Lewis M. Destramps, Fall River, and Nat. C. Smith, New Bedford, architects; to be constructed of brick and stone. A new Court House at Worcester, to cost $375,000; Andrews, Jaques & Rantoul, architects. A society building, to cost $18,000, at Derby, N. H., for the I. O. O. F. Society; Geo. G. Adams, architect; to be constructed of brick. A new combination store and office building at Providence, R. I.; Wm. R. Walker & Son, architects; to be constructed of buff brick and terra-cotta. The Phœnix Hall at Brockton (steel frame fire-proof building); Fuller, Delano & Frost, architects, Worcester; to be constructed of brick and stone. A new $30,000 dormitory for Smith's College, Northampton, Mass.; W. C. Brocklesby, architect, Hartford. Home for Aged Couples at Manchester, N. H.; William N. Butterfield, architect, Manchester; to be constructed of brick. A $25,000 cold storage plant at Waterbury, Conn.; A. B. Pinkham, architect, Boston; to be constructed of brick and terra-cotta. A new school-house, to cost $25,000, at Mattapoisett, Mass.; Charles Brigham, architect, Boston; to be constructed of brick. The high school at East Boston, for which plans were in competition, has been awarded to John Lyman Faxon, and is to be constructed of brick and stone. The schoolhouse for Haverhill, Mass., has been awarded

RESIDENCE AT PITTSBURGH, PA.
George S. Orth, Architect.
Front brick made by the Harbison & Walker Company, Pittsburgh, Pa.

MT. ALOYSIUS ACADEMY, CRESSON, PA.
Alden & Harlow, Architects.

to C. Willis Damon, architect, Haverhill; to be constructed of brick and stone. A new $60.000 schoolhouse at Malden, Mass. Plans in competition; to be constructed of brick. A new combination store and office building at Worcester, to cost $75,000; Earle & Fisher, architects, Worcester; to be constructed of brick and stone.

CLEVELAND.—The second annual exhibition of the Cleveland Architectural Club closed November 27, after a successful run of two weeks, on the tenth floor of the New England Building, where ten large rooms and the corridor were completely filled with between 700 and 800 different drawings, photographs, water and oil colors, statuary, and the advertising exhibit.

The exhibition was divided into two parts: the regular architectural work and the exhibits by advertisers.

In the latter, interesting and artistic exhibits were made by all who took space in the catalogue. Three of the rooms were devoted to this feature.

The memorial collection of the life work of Richard Morris Hunt, loaned by Mrs. Hunt and Mr. R. H. Hunt, was given the place of honor, being located opposite the main entrance. It proved of much interest to all patrons of the exhibition.

The work of the architectural schools attracted much attention, and many questions were asked regarding methods and courses of study of these institutions; Harvard, Columbia, Atelier Masquery, University of Pennsylvania, Philadelphia School of Industrial Art, and Cornell being represented. The drawings by students of the Ecole des Beaux Arts, Paris, exhibited by, and the property of Cornell University, were most carefully and critically examined for their wonderful technical value. They were twelve-hour problems.

The government exhibit of post-offices and custom houses, recently exhibited at the Nashville Exposition, was also of interest, because of the advance shown in the design of many of the buildings. Especially interesting were the two designs rendered by Messrs. D. A. Gregg and C. D. Maginnis.

Boston was well represented by the work of Messrs. Blackall, Freethy, Gregg, Le Boutillier, Little & Browne, Schweinfurth, Peabody & Stearns, and Winslow & Wetherell.

The design for the new Cleveland Chamber of Commerce, by Peabody & Stearns, was very much admired.

The exhibition possessed one feature of merit which popularized it with the public, *i. e.*, its many exquisite water colors. So many and varied were they that every room was given a goodly quota. Of these, the work shown by Messrs. Ross Turner, J. A. Schweinfurth, Geo. P. Fernald, A. Kahn, Emil Lorch, Chas. S. Schneider, W. M. Hall, W. D. Benes, Frank A. Hays, Jamieson, and A. C. Mûnoz, and Misses Reade and Burgess deserves prominent mention.

GOODRICH HOUSE, CLEVELAND, OHIO.
Coburn, Barnum, Benes & Hubbell, Architects.

In interior decorations many pleasing designs were shown; those by Messrs. W. T. Supplee, Nicola d'Ascenzo, and G. Ketterer, of Philadelphia; Louis Rohrheimer, Cleveland; and Misses Christia M. Reade and Ida J. Burgess, of Chicago, being the most meritorious.

The work of the Cleveland Club consisted of the competition drawings of the year past, and that of its individual members. Coburn & Barnum exhibited two views of a residence now building for Mr. W. H. Lawrence, at Dover Bay Park. This house is of brick and terra-cotta, with tile roof, with interior construction of steel and fire-proofing.

Coburn, Barnum, Benes & Hubbell (firm now dissolved) exhibited views of the Goodrich House and Western Reserve Historical

ENTRANCE, GOODRICH HOUSE.

Society Building, both brick and terra-cotta buildings, the latter being absolutely fire-proof.

Knox & Elliot made a very interesting show of their work Granger & Meade occupied a goodly space with residence work, in which they have become so successful. Willard Hirsh's design for one of Cleveland's branch libraries attracted deserved attention. The building is in Roman brick and is well executed. Chas. W. Hopkinson made a goodly showing of executed work. Hubbell & Benes showed a number of clever designs of proposed buildings. Lehman & Schmitt's designs for an office building and residence of F. W. Bruch commanded attention. Arthur N. Oviatt's views of the Century Club were much admired. These club rooms are located on the fifteenth floor of the New England Building and are the finest in the city. W. W. Sabin's design for Eldred Hall at W. R. U., and Wm. R. Watterson's competitive design for the Cleveland Chamber of Commerce were carefully inspected.

The catalogue issued for the exhibition has received many flattering comments, and such a demand has been made for it that the issue is nearly exhausted.

PITTSBURGH. — There has been considerable activity in the building line during the fall. Many of our architects are now engaged on competitive drawings or laying out new work for next season, which would indicate considerable business for the coming spring. The Washington county commissioners have invited six architects to compete for the new court house plans; among those of this city are W. Kaufman, F. J. Osterling, and F. C. Sauer. The Pennsylvania Railroad Company will soon have plans ready for a new Union Depot to be erected on the site of the present structure. The Daughters of the Revolution have authorized Architect Miss E. Mercur to prepare plans for a custodian building which will be erected on the old Block House property at the Point. The school directors of the Third Ward, Allegheny, have adopted the plans submitted by Architect F. C. Sauer, for their new school building. Architect Joseph Anglin will prepare plans for a three-story brick and stone hall building, 60 by 120, for the Fraternal Hall Association, to be erected at McKee's Rocks. Architects George Orth & Brother are preparing plans for a three-story brick warehouse for Jacob Graff, to be erected on Penn Avenue, East End. Architect Sidney Heckert has prepared plans for a large residence, to be built of Pompeian brick and stone, for Harry Robins, and to cost $45,000.

INTERESTING NEWS ITEMS.

THE CUMMINGS CEMENT COMPANY have secured another large contract to furnish their Obelisk (Natural) and Storm King (Portland) brands for canal work. This will necessitate running the works most of the winter.

THE Bolles Sliding and Revolving Sash have been specified for the new twelve-story office building corner Charles and Fayette Streets, Baltimore, Md.; Winslow & Wetherell, architects, Boston, Mass.

O. W. PETERSON & CO., Boston, have removed their office from 611 to 505 John Hancock Building. They now have a fine exhibit room, in which is shown a full line of dry pressed and stiff mud-clay products.

WALDO BROTHERS have secured the contract for furnishing Atlas Portland cement to B. T. O'Connell, for approach of new Charlestown (Boston) bridge. The price was considerably in excess of other American Portlands, but Atlas was the only brand submitted that passed the test.

THE HYDRAULIC-PRESS BRICK COMPANY, of St. Louis, have closed contract with Drainage Commission, of New Orleans, La., for 100,000 enamel brick for various pumping stations; work to commence at once. They are now putting on the market a white brick with an impervious non-absorbent face and without a glaze. On

MAIN ENTRANCE, GOODRICH HOUSE.

PORTION OF FRONT OF BUILDING FOR EVANS ESTATE, BUFFALO.
E. A. Kent, Architect.
Terra-Cotta executed by the Northwestern Terra-Cotta Company.
(The whole front of this building is of terra-cotta.)

account of the increased demand for enamel brick they have been compelled to add to their already large kiln capacity.

THE winding iron stairs in the building of the Boston Art Club, on Dartmouth Street, have been covered with their protective device by the American Mason Safety Tread Company, constituting a safeguard which will be much appreciated by members and guests of the club.

WALDO BROTHERS will supply Atlas Portland cement to Joseph Ross for work at foot of Summer Street, Boston, part of Terminal Station improvement, the cement being approved by Wm. Jackson, city engineer, after careful tests.

HOLBROOK, CABOT & DALY have purchased of Waldo Brothers Atlas Portland and Hoffman Rosendale for their contracts for city of Boston abutments at Back Bay Fens, also for New York, New Haven & Hartford Railroad work at Readville, Mass.

THE CELADON TERRA-COTTA COMPANY, LIMITED, Charles T. Harris, Lessee, has closed contracts for roofing tile for Emerson Hall, Beloit College, Beloit, Wis., wave pattern; Patton & Fisher, architects, Chicago. Residence for Wm. Guernsey, Chicago, 8 in. Conosera, Geo. L. Harvey, architect. Residence for Nathan Herzog, Chicago, open shingle; Handy & Cady, architects.

THE architectural terra-cotta for "The Westminster," Copley Square, Boston, H. E. Cregier, architect, Woodbury & Leighton, builders, will be furnished by Waldo Brothers, who are agents for the Perth Amboy Terra-Cotta Company. This is the largest contract for terra-cotta which has been awarded in Boston in a long time.

THE DAGUS CLAY MANUFACTURING COMPANY, manufacturers of front brick, report a business that keeps their plant running on full time. They have recently opened a new clay bank, located on their premises, which yields a clay that makes a very handsome shade of buff brick. Among the contracts recently closed by this company is one for 40,000 pink Roman brick for a residence at Buffalo.

MR. JAMES R. PITCAIRN, of 337 Fifth Avenue, Pittsburgh, Pa., is now the Pittsburgh agent of the Ridgway Press Brick Company, of Ridgway, Pa. Mr. Pitcairn, although having had the agency of the "Ridgway" product for but a few months, has already furnished their mottled grays for two very creditable operations, and their stiff mud buffs for two more, and has now orders in at the factory for four large operations to be built of mottled gray Roman brick.

ANTHONY ITTNER, the well-known brick manufacturer of St. Louis, reports a decided improvement in his business. The demand for his pressed and ornamental bricks for shipment to distant points has been a conspicuous feature of his business for the year. One of these orders called for 100,000 bricks to be shipped to Dallas, Texas, for the St. Paul's Sanitarium, and another for a shipment to Fort Cook, Neb.

POWHATAN CREAM-WHITE BRICKS have been used in the following operations in New York City: Apartment house, 107th Street, near Amsterdam Avenue; W. J. Casey, builder. Apartment house, northwest corner 86th Street and Central Park West; James

ST. FRANCIS CHURCH, COLUMBUS, OHIO.
Yost & Packard, Architects.
Built of rock-faced and plain bricks, made by the Columbus Brick & Terra-Cotta Company.

Livingston, builder. Business building, 590 Broadway; J. A. Zimmermann, builder. Light Courts St. James Building, Broadway and 26th Street; S. E. Moore, contractor.

The Central Fire-proofing Company have recently taken contract to furnish and set in place, the terra-cotta fire-proofing for Bellefield Hotel near Pittsburgh. They are now furnishing and setting fire-proofing for the Land Title & Trust Building, Philadelphia, and Arbuckle Sugar Refinery, Brooklyn. They are also furnishing material for Pavilion Building, Boston, Astoria Hotel, Syndicate Building, Park Row, Columbia College Building, New York University Buildings, and many others in New York city.

The Ridgway Press Brick Company, through their Pittsburgh agent, Mr. Jas. R. Pitcairn, are furnishing the mottled gray Roman brick for Joseph Horne & Co.'s new six-story store building at Pittsburgh.

Joseph Horne & Co. are the largest wholesale and retail dry goods, etc., dealers in Western Pennsylvania, and this store, when completed, will make a notable addition to Pittsburgh's already long list of fine buildings. Peabody & Stearns, of Boston, are the architects; Henry Shenk & Sons, general contractors; and C. B. Lovatt & Bro. are the bricklaying contractors.

A CITY RESIDENCE.
Hobart A. Walker, New York, Architect.

We are in receipt of a very attractive pamphlet of some ten pages from the Illinois Steel Company, Chicago, describing the character and merits of their steel cement. This cement is manufactured mainly from the blast furnace slag obtained from the smelting of iron ores. It is ground to the greatest possible degree of fineness and is claimed to be particularly desirable for heavy concrete work where high strength is required. In the pamphlet is also recorded a number of tests of steel cement. Accompanying these tests there are some very flattering testimonials from prominent concerns who have used the cement and endorse it as being entirely satisfactory.

STORE BUILDING, DETROIT, MICH.
Gustav A. Mueller, Architect.

A new candidate for honors in the way of enamel brick is the Pennsylvania Buff Brick and Tile Company. Office, Trenton, N. J.; works at Saylorsville, Pa. For the past two years the company have been conducting a line of experiments on enamel bricks in an extensive way, and are now turning out a most desirable article. During the last six months they have made many alterations and additions to their already extensive plant in order to be fully equipped to handle to the best advantage the large business they anticipate on this branch of their output. The conservative, methodical progress which the company has made in the production of satisfactory enamels would indicate that they are upon a proper basis to satisfactorily supply the demand for a good enameled brick.

The Pancoast Ventilator Company has bought out the interest of Mr. R. M. Pancoast, who has resigned the vice-presidency and withdrawn from all connection with the company. They report a very gratifying increase in their business. Beside the contract for supplying the ventilators for the Astoria Hotel and a ten-foot ventilator for the Manhattan Beach Theater, they have had them specified for the new Liberty Silk Mills, at 57th Street, New York, and a 66 in. one for the Purdue University, of Lafayette, Ind. In addition to their regular line of ventilators, they have a new Common Sense ventilator, which is much appreciated by those in offices and sleeping rooms.

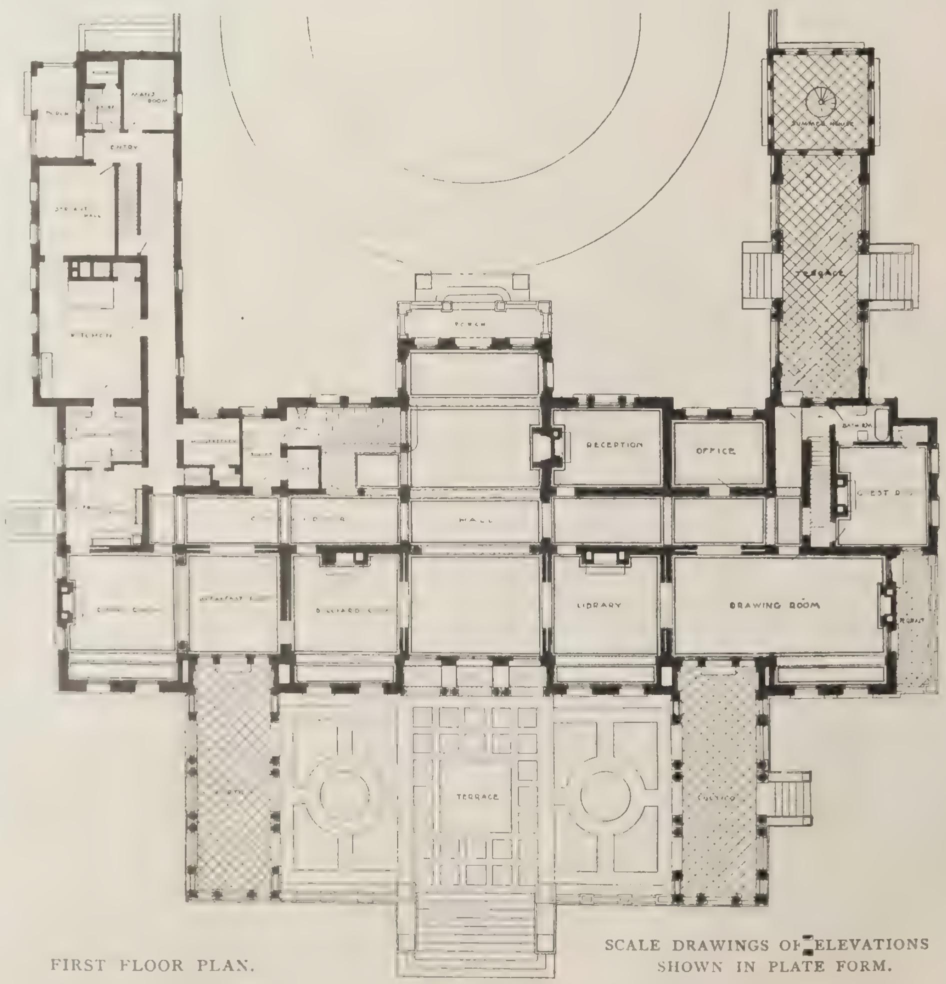
THE COLUMBUS BRICK AND TERRA-COTTA COMPANY have closed the following contracts to supply their bricks in New York City: Two flats, 112th Street, light-gray standards; Edward Wenz, architect. Four flats, 119th Street, light-buff standards; John Brandt, architect. Flats, 116th Street, dark gray Romans; G. A. Shellinger, architect. Grammar School No. 13, Huston Street, light-buff standards; C. B. J. Snider, architect. Stable and dwellings, 77th Street, terra-cotta Romans; A. M. Welch, architect. Two flats, 103d Street, dark-gray Romans; G. F. Pelham, architect. Office building, Broadway and 19th Street, gray speckled Roman. The following list of buildings in other localities are being supplied with their bricks: Arnold Building, Knoxville, Tenn., light-gray standards; Baumann Bros., architects. Stores and offices Napoleon, Ohio, gray standards; E. O. Fallis, architect, Toledo, Ohio. "Majestic" apartment, Atlanta, Ga,. light-buff standards; Willis F. Denny, architect. Chapel, Soldiers' Home, Dayton, Ohio; dark-buff standards. Residence, R. H. Morrison, Charleston, W. Va., terra-cotta Romans; Harrison Albright, architect. Bank, Tarrytown, N. Y., light-buff standards; Robertson & Manning, architects. Store, Elder & Tuttle, Springfield, Ohio, terra-cotta and gray. Burt's Theater, Toledo, Ohio, light-buff and dark-gray standards; Mills & Wachter, architects.

COURT, HOUSE FOR H. H. COOK, ESQ., LENOX, MASS.
Peabody & Stearns, Architects.

WE have recently had our attention called to the Standard System of Slate Fastening as being one which combines many good points in the fastening of slate shingles and obviates many bad ones, and we are glad to bring the same to the further notice of our readers. This system is known as the Standard Slate Fastener, and is a simple yet most practical device for the securing of slates to the roof in an absolutely rigid manner. The fastener is made from galvanized steel wire cut in lengths from 4 to 5 ins., bent at one end in the form of a crook, and at the other, so as to make a sharp angle at about 1½ ins. from its termination. This end is made with a sharp point and is to be driven to the depth of its elbow into the roof proper, which brings the main shank of the fastener flush with the roof, and allows the crook to project to its own height (½ in.).

The end of the slate at about its center is then slipped into the crook and held there in a secure manner. As the fastener is from 2 to 3 ins. in length from the elbow to the crook, it allows the next layer of slate to overlap the preceding one just that distance, and as each fastener is driven between the joints, there is no punching of holes in the slate. The fastener comes also with snow-guard attachment if desired. It is claimed by the company that 50 per cent. is saved in time of laying slate by the use of this system over any other.

Parties interested may obtain full information by writing the manufacturers, Hamblin & Russell Manufacturing Company, Worcester, Mass.



FIRST FLOOR PLAN.

SCALE DRAWINGS OF ELEVATIONS SHOWN IN PLATE FORM.

HOUSE FOR H. H. COOK, ESQ., LENOX, MASS.
Peabody & Stearns, Architects.

WE are in receipt of the new illustrated catalogue issued by Henry Maurer & Son, New York City. This is a particularly interesting work of about one hundred pages, and shows every evidence of great painstaking in its compilation; while primarily its object is to describe the particular products of the above-named company, yet there is incorporated in its pages much general information regarding

the practical use of burnt-clay fire-proofing. Several pages are devoted to the enumeration of a list of over three hundred large buildings, located in various parts of the country, for which the company furnished the fire-proofing. Following this are some sixty pages devoted to a full and comprehensive description of the various fire-proof arches, partitions, furring, column covering, roof and ceiling tiles, etc., which the company manufactures. These are further explained by twenty-two colored plates, illustrating their various purposes. In connection with this portion of the catalogue there are introduced a number of interesting extracts from articles written by various authorities pertinent to the subject of proper fire-proof construction, also a review and criticism of some public tests of fire-proofing made at different times in New York City and elsewhere.

In the closing pages of the catalogue there are twenty-nine full-page half-tone illustrations of prominent buildings recently constructed in New York and Philadelphia, for which this company supplied the fire-proofing. The general excellence evinced in the arrangement of the catalogue, and the real value of the matter encompassed in its pages makes it a volume to be desired by all interested in the subject of fire-proof construction.

RESIDENCE OF H. H. COOK, ESQ., LENOX, MASS.
Peabody & Stearns, Architects.

THE NEW YORK AND ROSENDALE CEMENT COMPANY furnished 65,000 barrels of cement for the New York Croton Aqueduct during 1897.

THE tests of Portland cement usually made as to fineness, tensile strength, at one and four weeks' setting, etc., do not afford an opportunity to ascertain if the cement under test possesses other qualities which for practical purposes are equally if not more valuable. The customary tests of cement give no evidence regarding its strength when mixed with a larger proportion of sand, regarding its uniformity, constancy of volume, durability, adhesiveness, impermeability, resistance to violent changes of the atmosphere, and to abrasion by wear. Information as to these qualities can only be obtained by the observation of long-time tests, the results of the employment of the cement in practise, which must be taken into consideration, together with the results of the usual tests, to form a judgment of the relative value of several cements.

The Dyckerhoff Portland Cement will pass the requirements of all tests compatible with the best quality, and the well-known results of its employment for more than thirty years have demonstrated that it possesses in the highest degree all the qualities desirable in a Portland cement, and justify the reputation that the Dyckerhoff is the best Portland cement made.

Mr. E. Thiele, 78 William Street, New York, is the sole agent for the United States for the Dyckerhoff Portland cement, and will be pleased, on application, to forward a pamphlet describing this cement more fully, and containing directions for tests, employment, and testimonials.

The Dyckerhoff Portland cement is for sale by Messrs. Ham & Carter, 560 Albany Street, Boston, and all the leading dealers in building materials throughout the country.

THE UNION AKRON CEMENT COMPANY, Buffalo, are supplying the cement for the new brewery building at Washington, Pa.; also large quantities of cement for work on the Erie Canal.

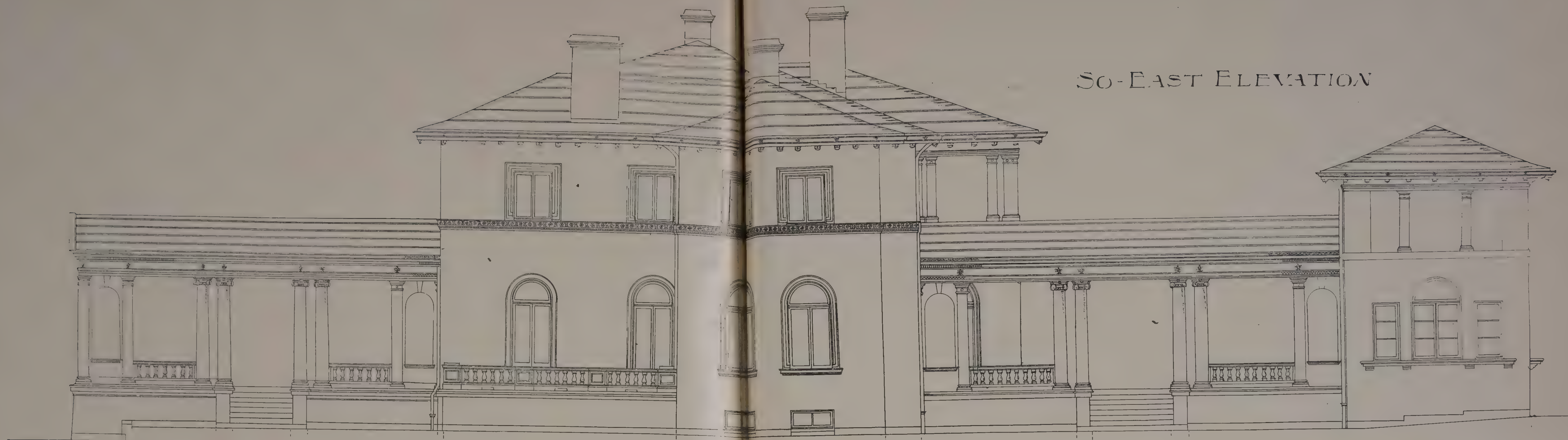
First Floor Plan.

A COUNTRY RESIDENCE.
CRAM, WENTWORTH & GOODHUE, Architects.

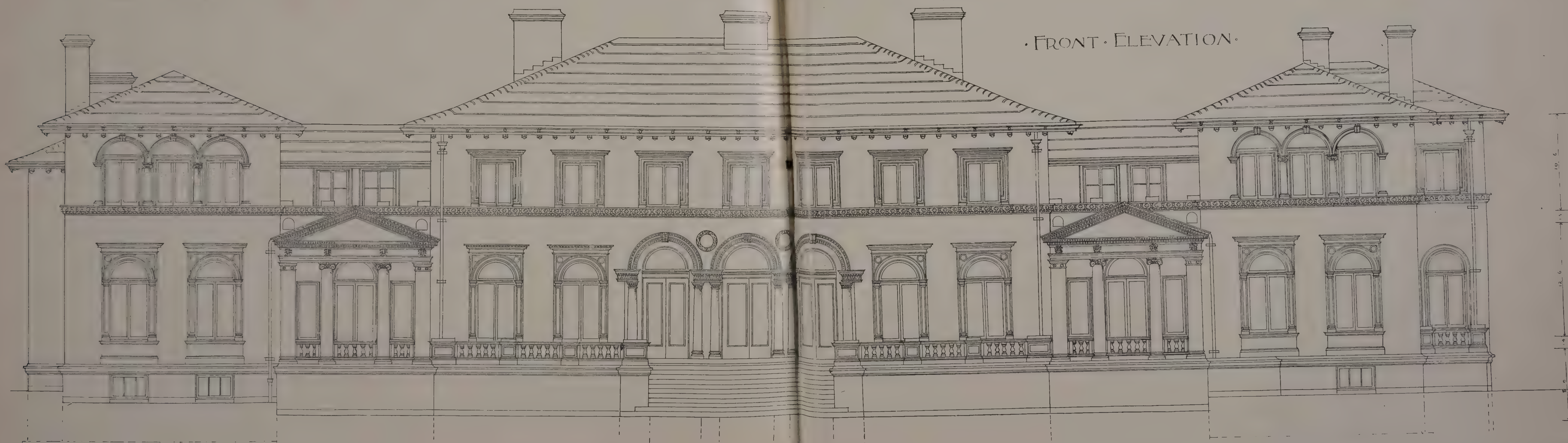
HOUSE FOR H.
PEAB DY

THE BUILDER.
VOL. 6. NO. 12. PLATES 99 and 100.

SO-EAST ELEVATION

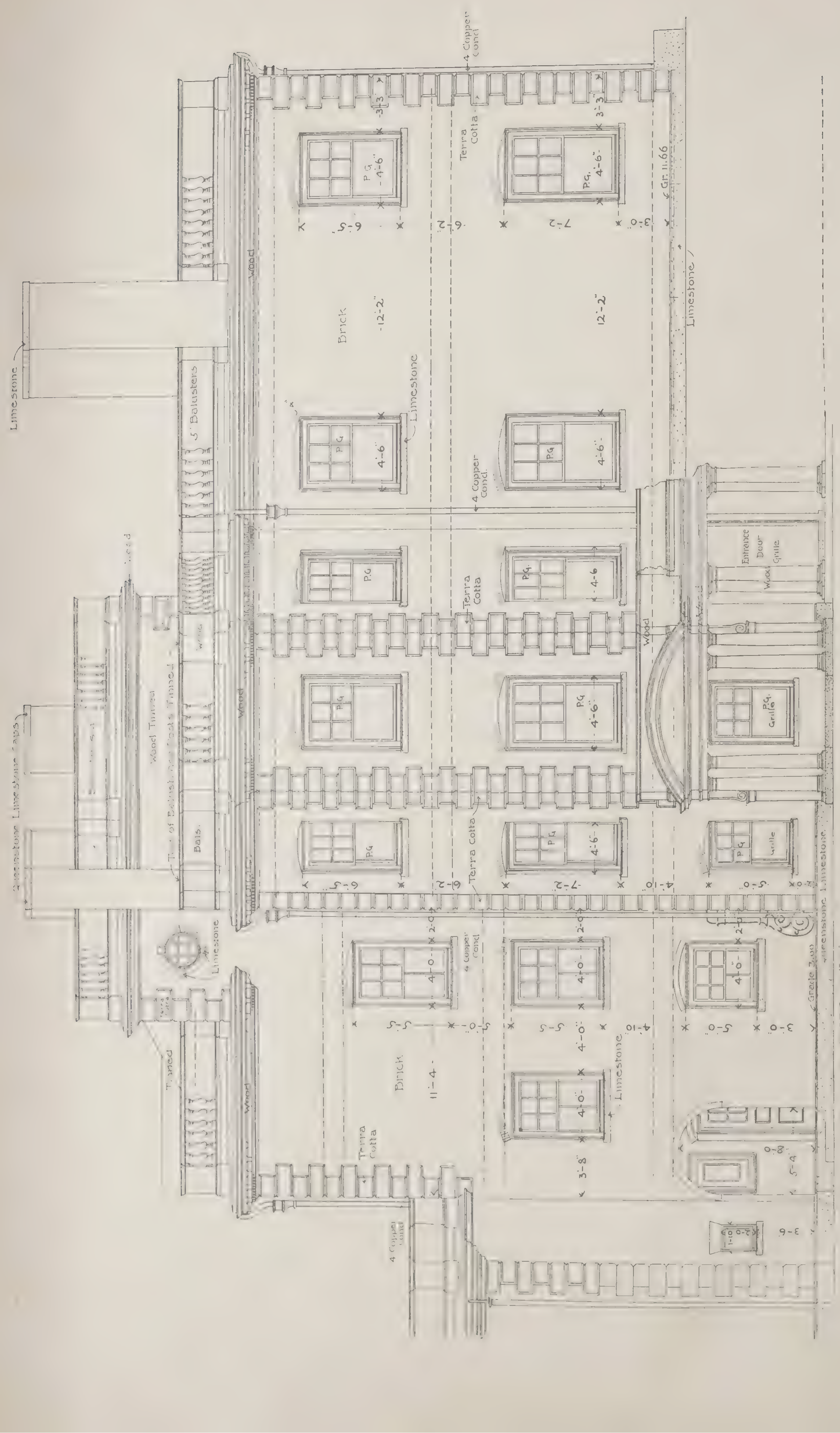


· FRONT · ELEVATION ·

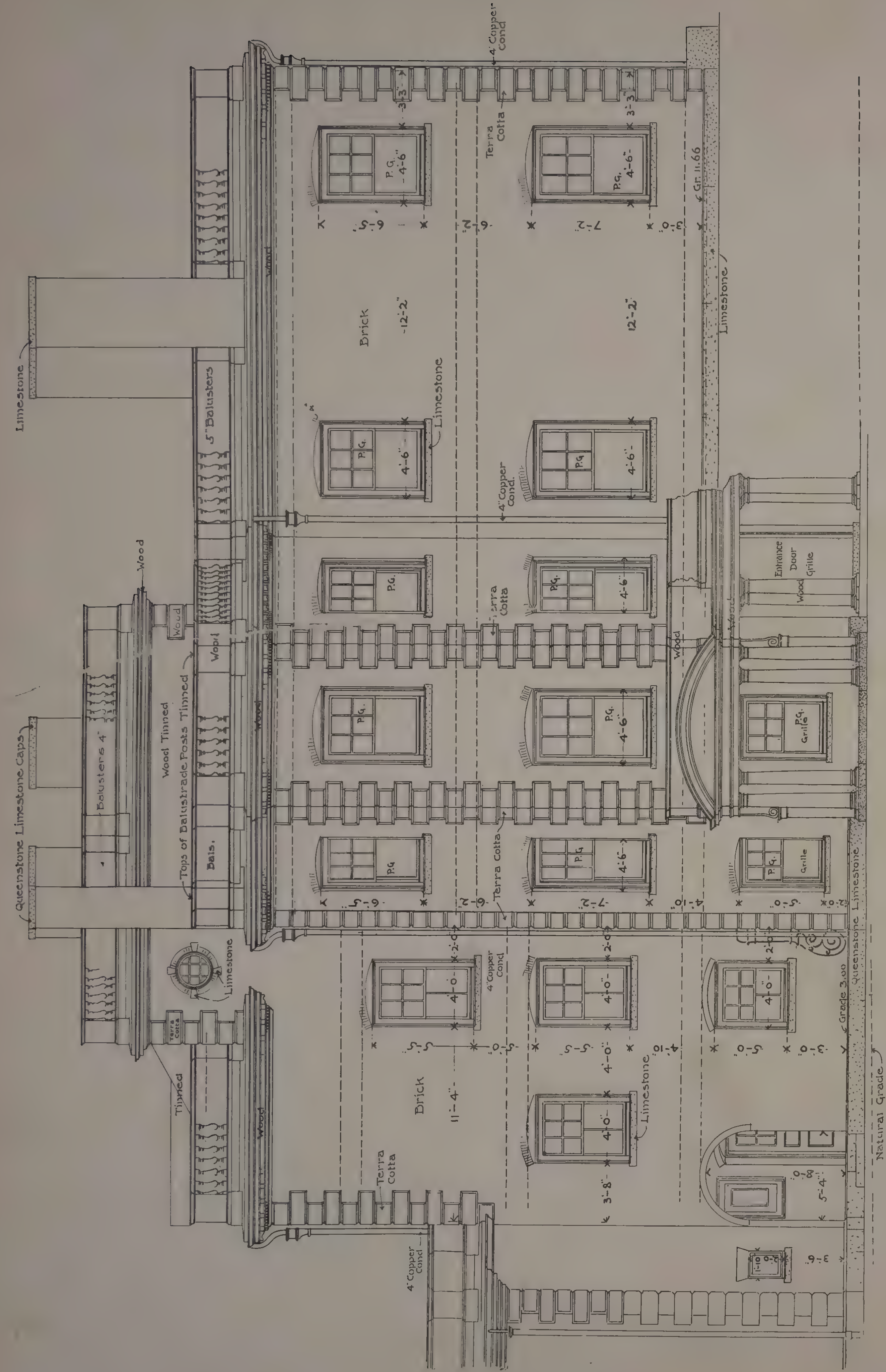


HOUSE FOR H. H. COOK, Esq., LENOX, MASS.

PEABODY & STEARNS, Architects.

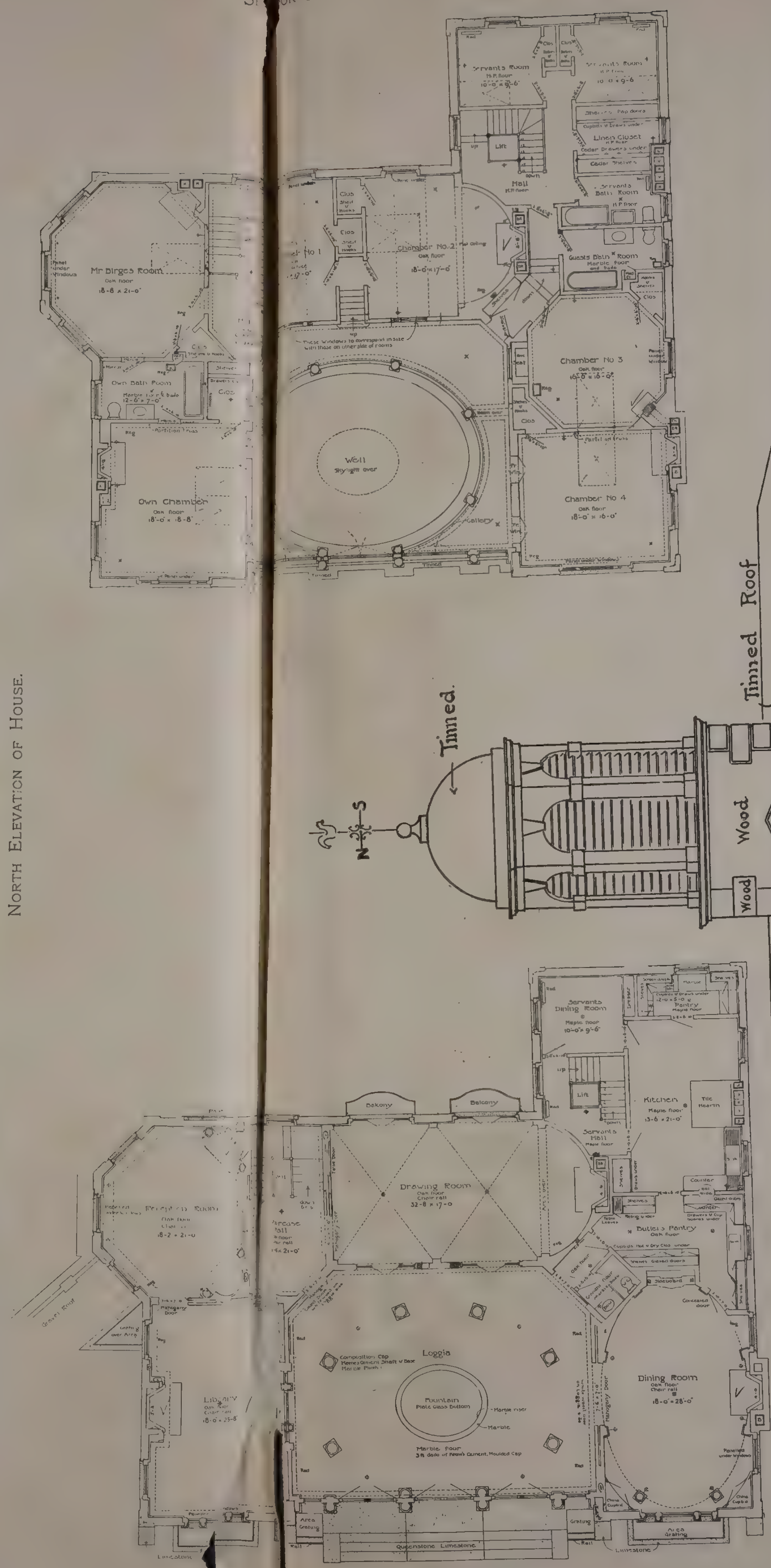


North Elevation of House.

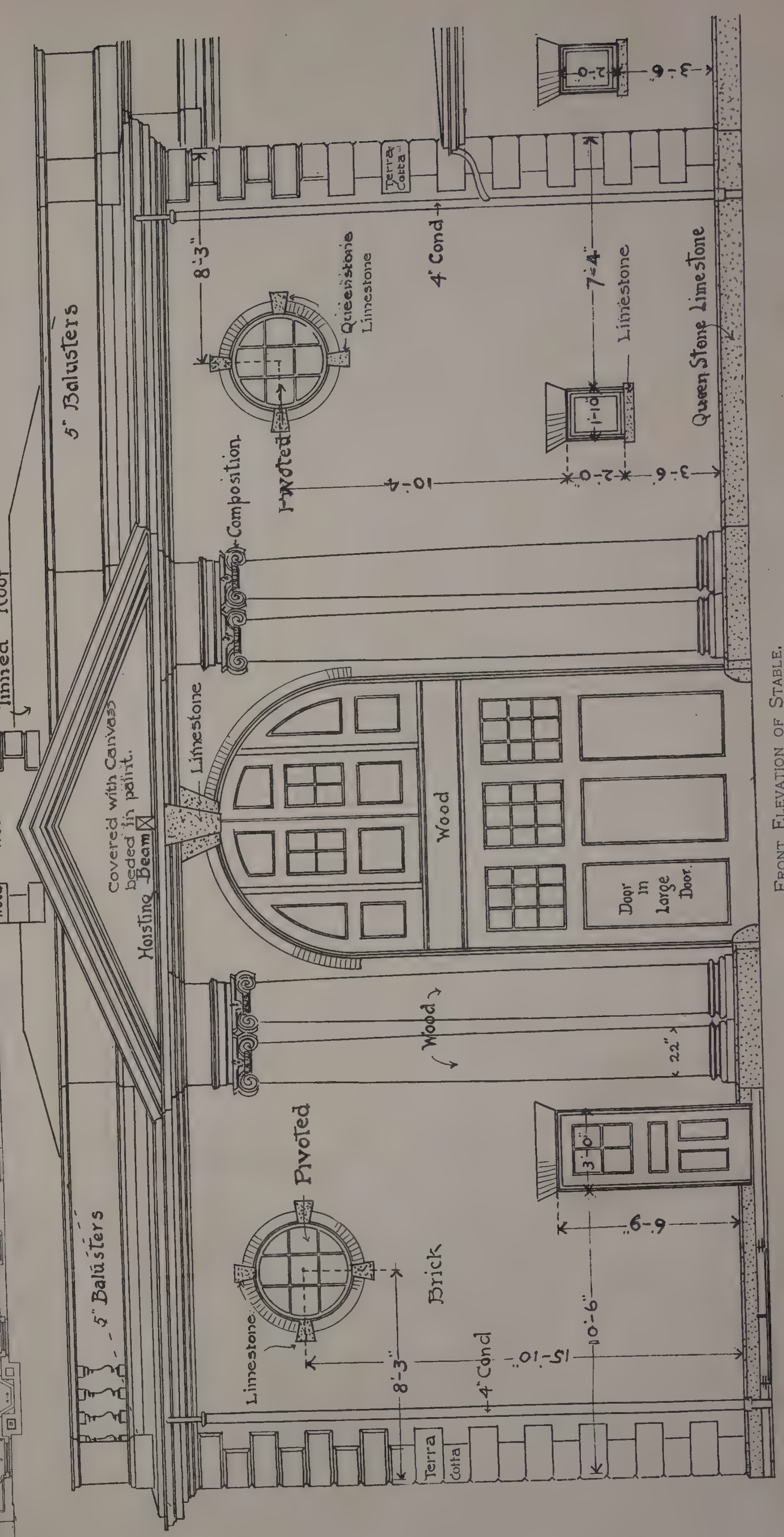


North Elevation of House.

Second Floor Plan.



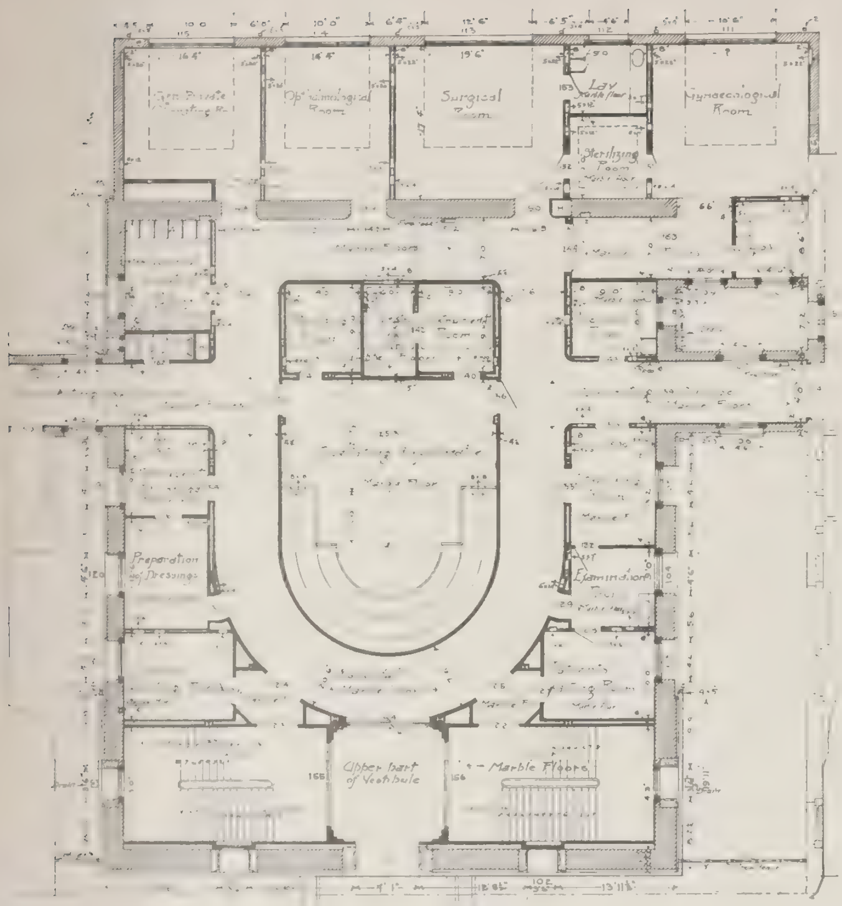
First Floor Plan.



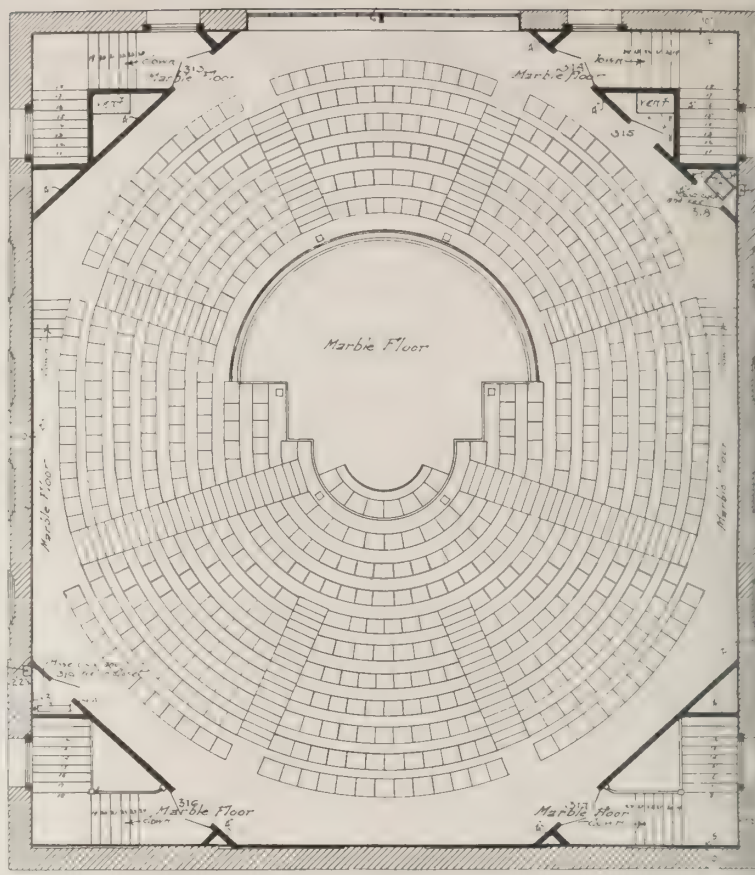
Front Elevation of Stable.

HOUSE AND STABLE FOR GEORGE K. BIRGE, Esq., AT BUFFALO, N. Y.

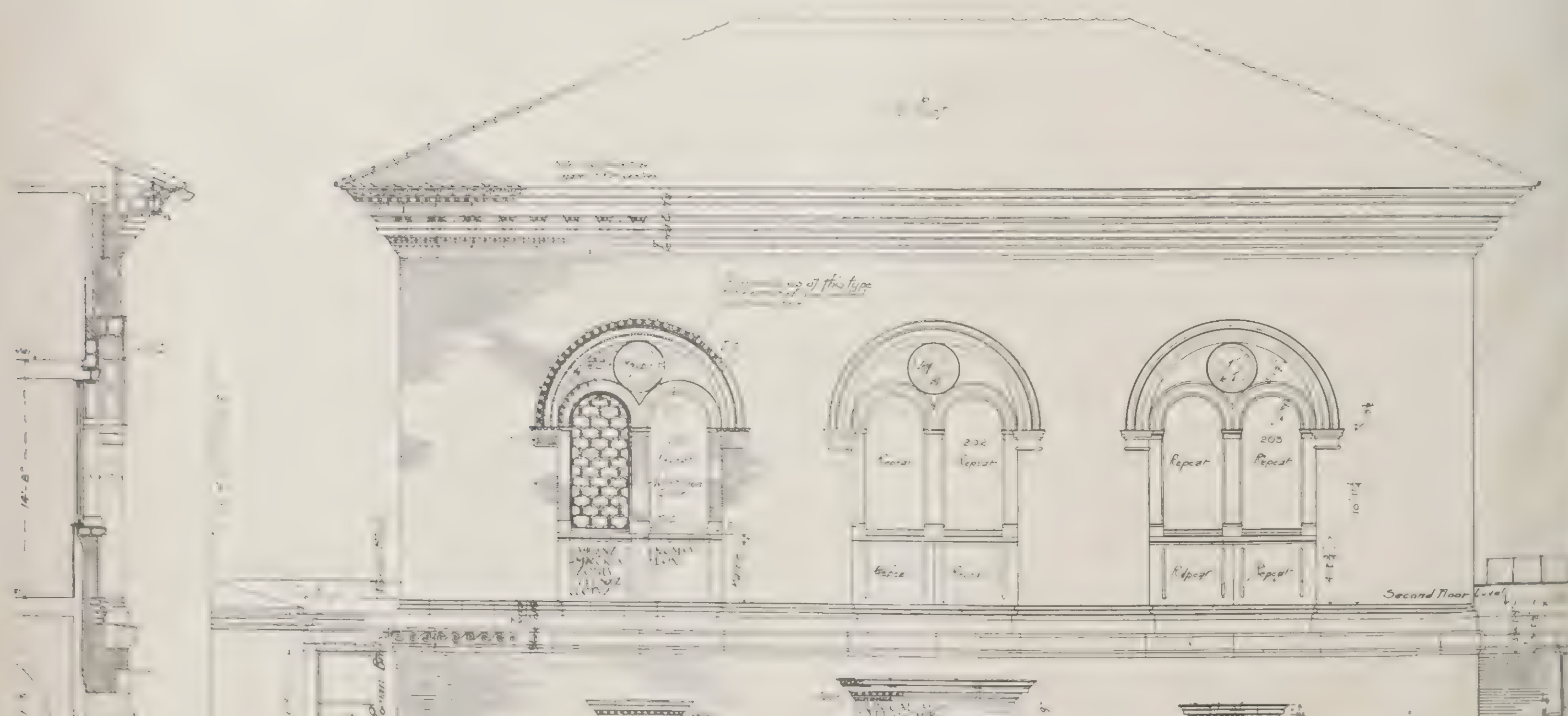
LITTLE & BROWNE, Architects.



First Floor Plan.

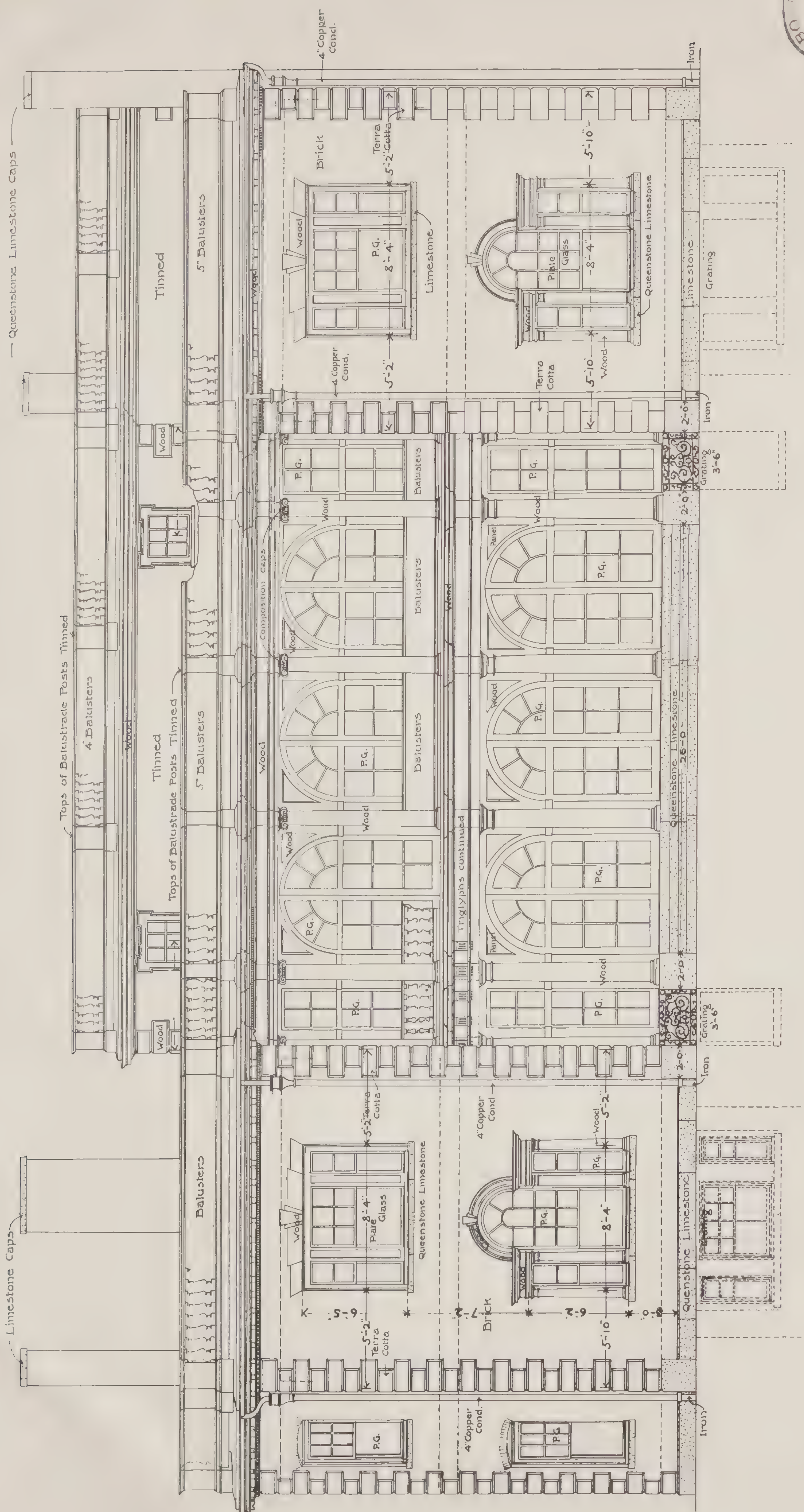


Third Floor Plan.



CLINICAL AMPHITHEATER, PHILADELPHIA, PA.

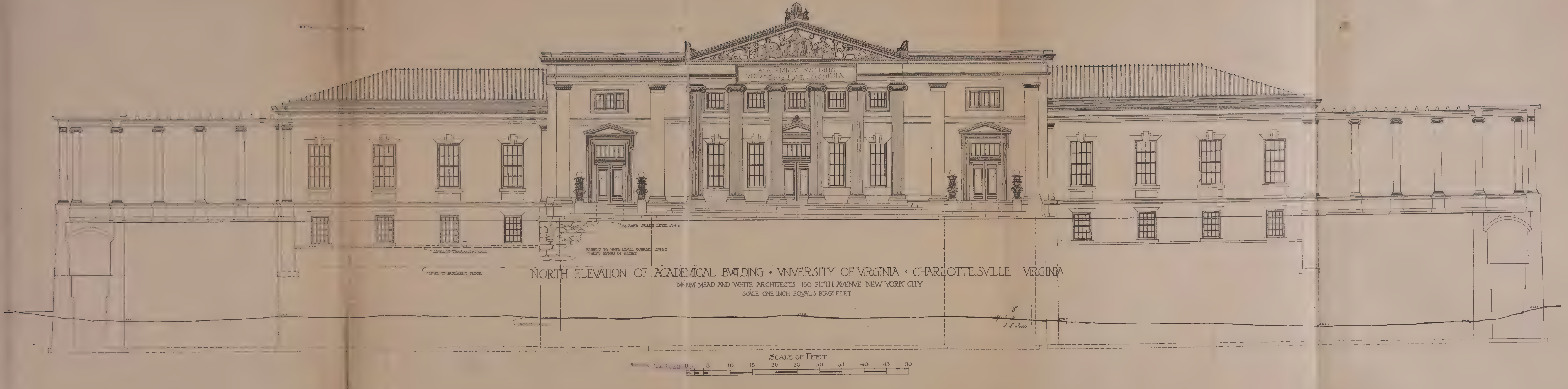
FRANK MILES DAY & BRO., Architects.

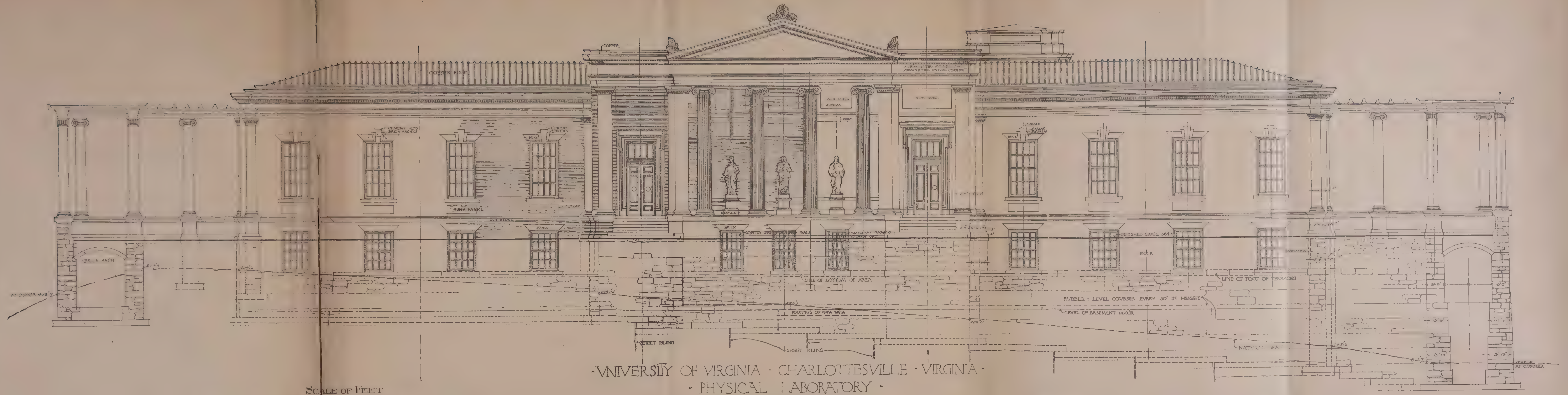


FRONT ELEVATION.

HOUSE FOR GEORGE K. BIRGE, ESQ., AT BUFFALO, N. Y.

LITTLE & BROWNE, ARCHITECTS.


ACADEMICAL BUILDING UNIVERSITY OF VIRGINIA
FINISHED GRADE LEVEL
RUBBLE TO HAVE LEVEL COURSES EVERY THIRTY INCHES IN HEIGHT
NORTH ELEVATION OF ACADEMICAL BUILDING • UNIVERSITY OF VIRGINIA • CHARLOTTESVILLE VIRGINIA
McKIM MEAD AND WHITE ARCHITECTS 160 FIFTH AVENUE NEW YORK CITY
SCALE ONE INCH EQUALS FOUR FEET
SCALE OF FEET
0 5 10 15 20 25 30 35 40 45 50



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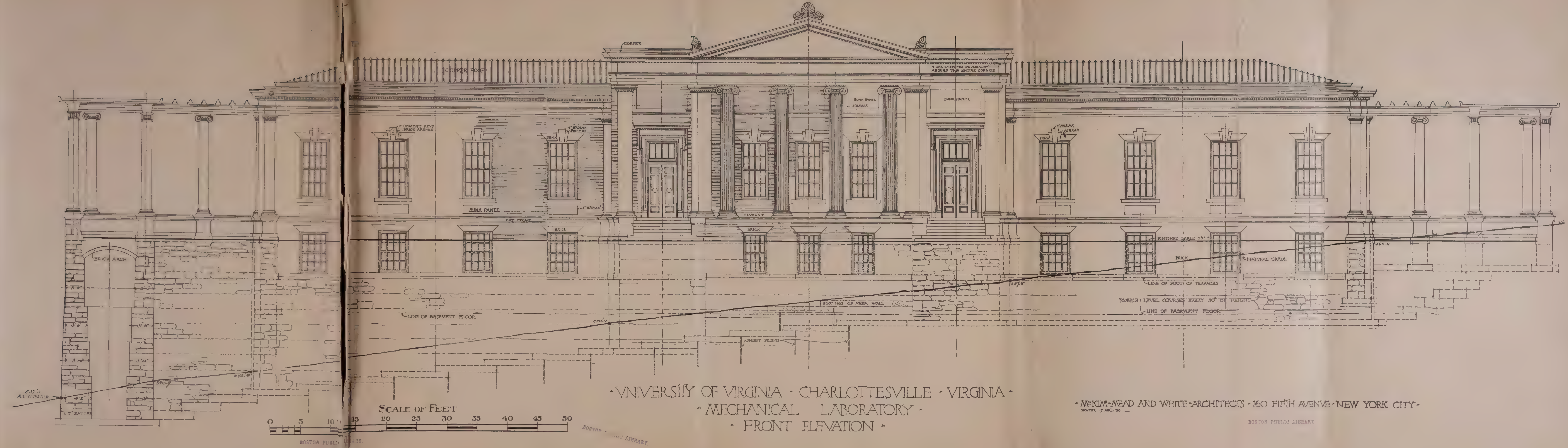
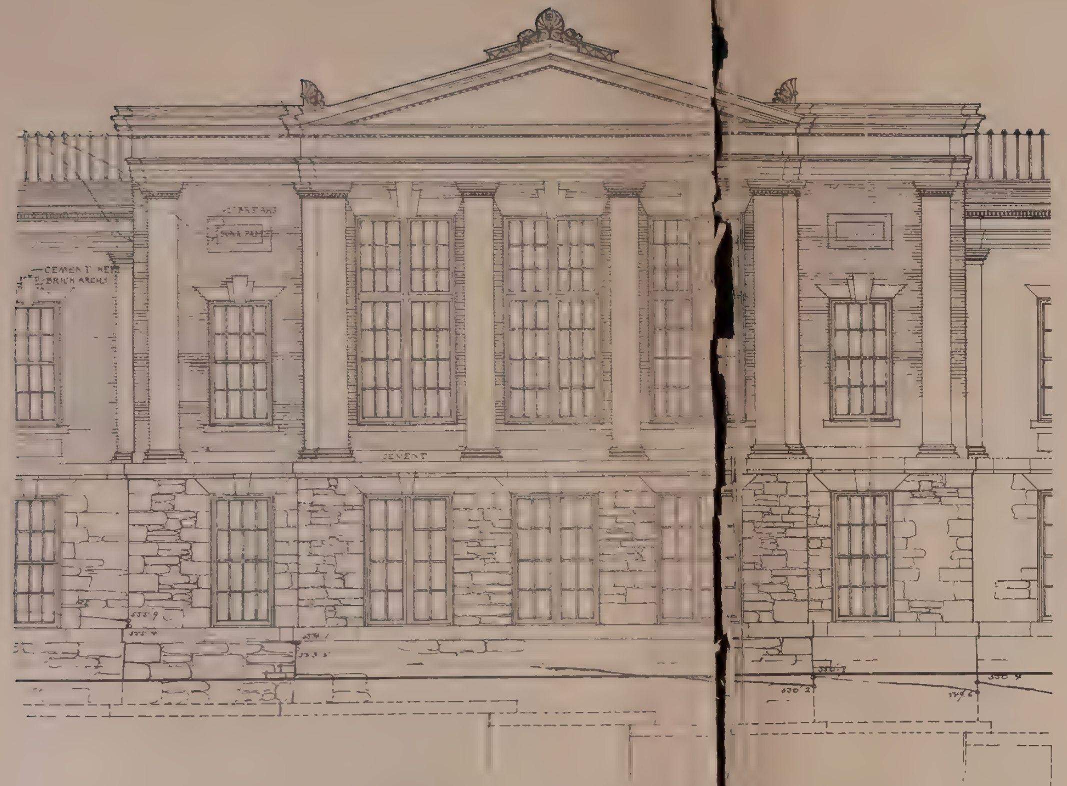
· PHYSICAL LABORATORY ·
· FRONT ELEVATION ·

·McKIM·MEAD AND WHITE·ARCHITECTS · 160 FIFTH AVENUE · NEW YORK CITY·



· VNIVERSITY OF VIRGINIA · CHARLOTTESVILLE · VIRGINIA ·
· MECHANICAL LABORATORY ·
· FRONT ELEVATION ·

· McKIM · MEAD AND WHITE · ARCHITECTS · 160 FIFTH AVENVE · NEW YORK CITY ·



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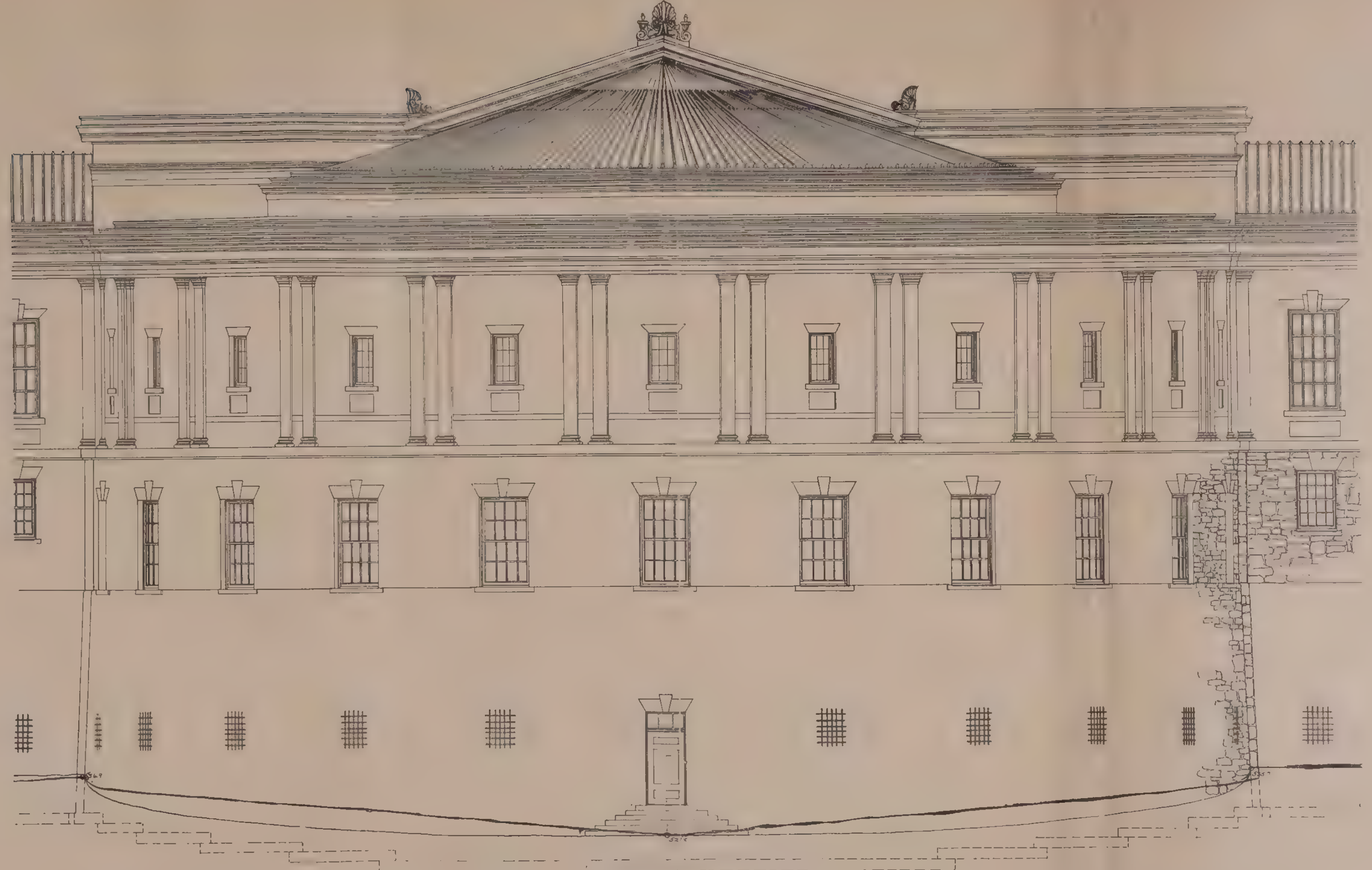

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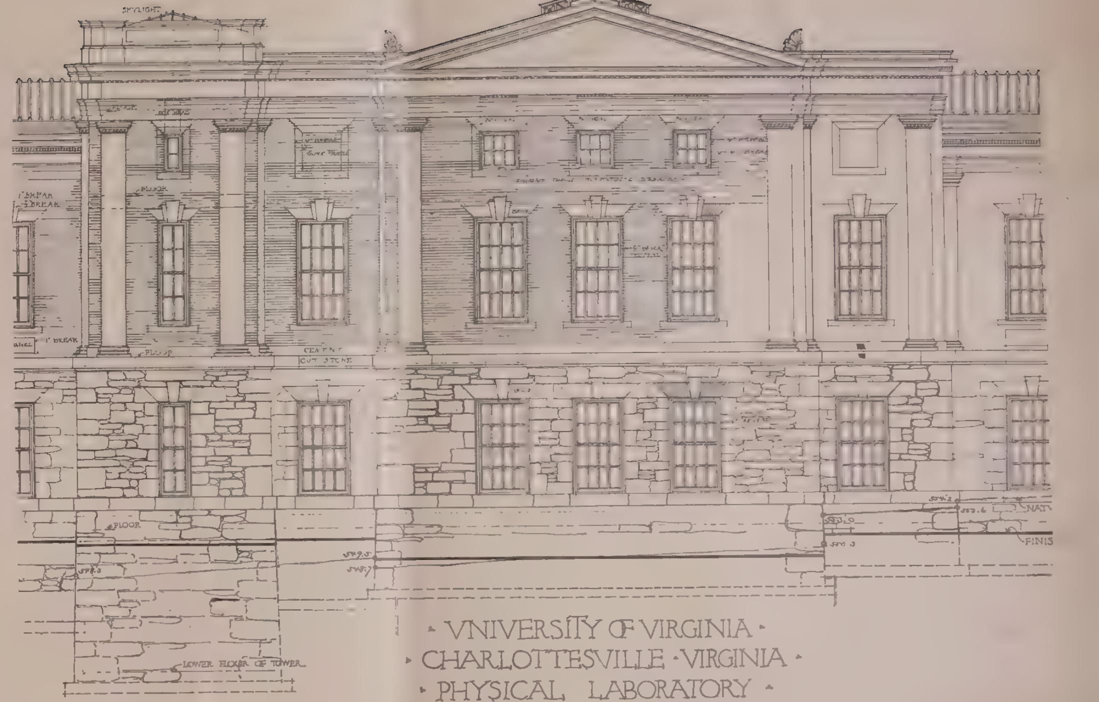

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VOLVME SIX
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DECEMBER MDCCCXCVII
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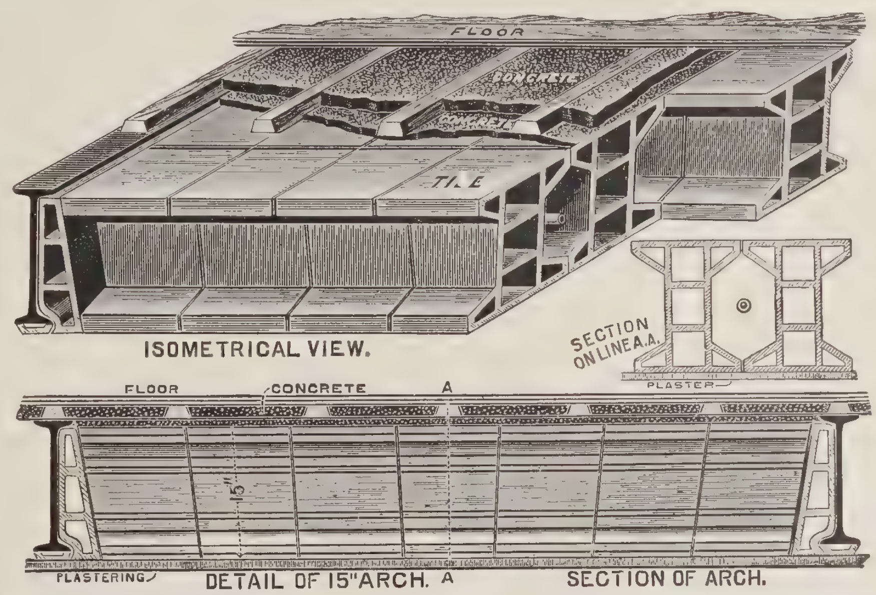

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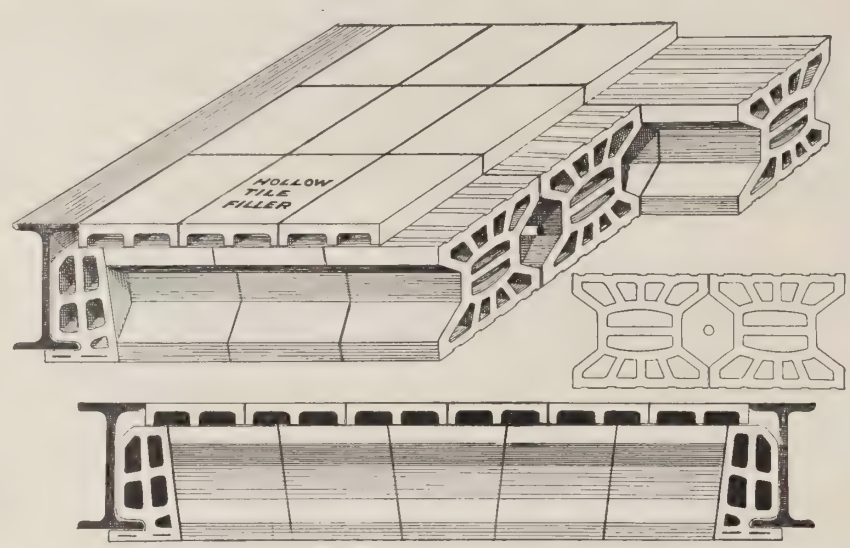

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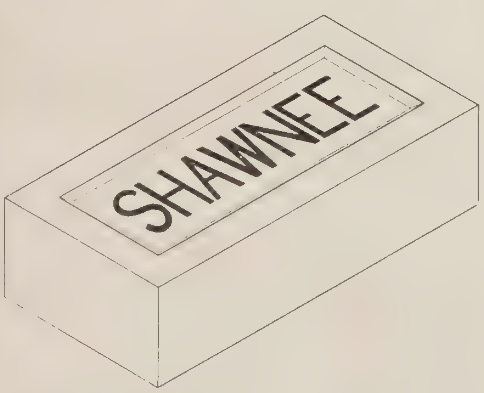

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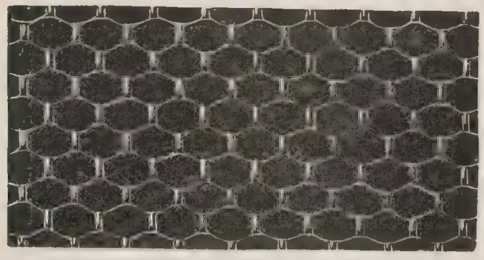

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